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**WATERSHED PLAN  
for**

**DRY CREEK WATERSHED**

**CLAY, CLOUD, REPUBLIC and  
WASHINGTON COUNTIES, KANSAS**

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WATERSHED PLAN

DRY CREEK WATERSHED

Clay, Cloud, Republic, and Washington Counties, Kansas

Prepared under the Authority of the Watershed  
Protection and Flood Prevention Act, Public  
Law 83-566, as amended (16 USC 1001-1008).

Prepared By

Dry Creek Watershed Joint District No. 57  
Clay County Conservation District  
Cloud County Conservation District  
Republic County Conservation District  
Washington County Conservation District

With Assistance By

U.S. Department of Agriculture, Soil Conservation Service  
U.S. Department of Agriculture, Forest Service  
Kansas State Extension Forestry  
Kansas State Conservation Commission

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MAY 08 1980

September 1979

CATALOGING = PREP.



PREFACE

This watershed plan was developed by the sponsors with assistance from the Soil Conservation Service and is the basis for authorization of federal assistance to implement the project in accordance with the Watershed Protection and Flood Prevention Act, Public Law 83-566, as amended (16 USC 1001-1008).

The plan contains information on goals of the sponsors, problems, planned project, installation costs, financing, benefits, and operation and maintenance. A Technical Appendix provides information on environmental conditions and project impacts, adverse environmental impacts which cannot be avoided, alternatives, relationships between short-term uses and long-term productivity, and irreversible and irretrievable commitments of resources.



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Dry Creek Watershed Plan  
Clay, Cloud, Republic, and Washington Counties, Kansas

SUMMARY AND DESCRIPTION

Dry Creek Watershed covers 15,232 acres in Clay, Cloud, Republic, and Washington Counties in northcentral Kansas. Project sponsors are Dry Creek Watershed Joint District No. 57 and Clay, Cloud, Republic, and Washington County Conservation Districts.

Major problems in the watershed are flooding and erosion. Average annual damages include: crop and pasture, \$23,600; other agricultural, \$4,500; road and bridge, \$2,900; railroad, \$1,900; flood plain scour, \$600; and indirect, \$3,600. Damages outside the watershed which will be reduced by the project include: crop and pasture, \$26,900; other agricultural, \$1,300; and indirect, \$2,800.

This project for watershed protection and flood prevention will consist of three floodwater retarding structures installed to control runoff from 10.03 square miles. Technical assistance through the going program will emphasize the importance of riparian woodland to wildlife. Going program technical assistance will also be provided on 1,000 acres of grassland and cropland during the project period.

Average annual flood damages in the watershed will be reduced 77 percent, and average annual flood damages outside the watershed caused by floodwater from the watershed will be reduced 62 percent by the project. Average annual soil loss in the watershed will be reduced about 5,400 tons. Average annual sediment yield to the Republican River will be reduced about 5,100 tons.

Impacts on stream water quality will be minimal and local because long periods of no stream flow are common. The major water quality impact will be reduction of sediment and associated nutrients.

Sediment pools created by dams will benefit aquatic wildlife. These pools will increase fishery potential and migratory waterfowl habitat.

Terrestrial wildlife habitat losses from structural measures will be partially compensated. The going land treatment program will improve terrestrial wildlife habitat. The wildlife habitat information program planned as part of this project will help to maintain and improve wildlife habitat.

Installation of the three floodwater retarding dams will take 4 years. Installation costs will total \$555,600 of which \$502,700 will be P.L. 566 funds.

Dry Creek Watershed Joint District No. 57 will operate and maintain structural measures. Estimated average annual operation and maintenance costs total \$1,900.

Annual benefits are expected to average \$52,400. Average annual costs for the structural measures are estimated at \$40,100.

Fire control protection measures on 5,571 acres of non-cropland are adequate. Technical assistance for fire protection can be obtained from the State and Extension Forester if the need arises.

#### PROBLEMS, PURPOSES, AND GOALS

##### Problems

Approximately 4,000 acres of cultivated land are subject to excessive sheet erosion; exceeding the tolerable soil loss of approximately 4 tons per acre per year. Total erosion in the watershed is about 46,000 tons per year. Flood plain scour is a problem in some areas along Dry Creek.

Sediment deposition occurs along the lower flood plain of Dry Creek. About 11,500 tons of sediment are delivered annually to the Republican River.

Floodwater damage to crops, pastures, other agricultural facilities, roads, bridges, and railroads averages \$32,900 annually. Annual damage from flood plain scour averages \$600. Indirect damages average \$3,600 annually. Dry Creek also causes damage to 1,280 acres of flood plain outside the watershed common with the Republican River. After discounting for damage caused by the Republican River, an average annual damage of \$31,000 is caused by overflows from Dry Creek (see Table 5 and Appendix A).

About five percent of the Dry Creek Watershed, or 714 acres, is categorized as riparian woodland. Conversion of any of these few acres to cropland or other uses reduces the wildlife population. Loss of wildlife habitat is a major problem within the watershed.

### Purposes and Goals

Project sponsors stated several goals in the watershed application. These guided initial planning and preliminary project formulation. Goals are to:

1. Reduce flooding within the watershed and on flood plain common with the Republican River. Damage of agricultural land, roads, railroads, bridges, and agricultural facilities are to be reduced.
2. Reduce erosion to tolerable soil loss on upland.
3. Reduce scour erosion on the flood plain.
4. Reduce gully erosion on upland.
5. Maintain existing and install needed conservation practices.
6. Conserve and improve terrestrial and riparian wildlife resources.
7. Reduce sediment yield at the watershed outlet.

### PLANNED PROJECT

#### Land Treatment Measures

No accelerated land treatment measures are included as a part of the project. About 70 percent of the land treatment needs in the watershed have been met.

Technical assistance, through the going program will be provided on 800 acres of cropland, 200 acres of grassland, and 170 acres of riparian woodland during the project installation period (see Table 1).

The Soil Conservation Service will provide land owners and operators technical assistance on management and maintenance of riparian woodland. The value of the 170 acres of existing riparian woodland will be discussed through a special wildlife habitat information program. The program will be funded through the going land treatment program but is a part of the planned project.

#### Structural Measures

Three floodwater retarding dams (see Project Map, Appendix E) will control drainage from 10.03 square miles;

42 percent of the watershed. These earthfill dams will have drop-inlet principal spillways and vegetated emergency spillways. (See Typical Earth Dam with Drop Inlet Spillway, Appendix D.)

Each dam will temporarily store floodwater in a detention pool and will have a sediment pool to store a 100-year sediment accumulation. Water will occupy sediment pools until they fill with sediment. See Table 3 for specific structure information.

Principal spillways to control discharges from the reservoirs will be made of reinforced concrete. Each spillway will have a single stage, ungated inlet. Release rates will average about eight cubic feet per second per square mile; will not exceed present downstream channel capacity; and will empty 80 percent of detention pool volumes in 10 days or less.

Each dam will have drawdown works with a control valve installed at the bottom of the inlet structure (see Appendix D). These works will permit release of water at elevations lower than the principal spillway inlet crest.

Each dam will have an emergency spillway designed to safely release runoff when inflow exceeds detention storage and principal spillway capacity. The chance of emergency spillway operation is 4 percent or less in any one year. Spillways will be vegetated to protect against erosion.

Sufficient borrow can be excavated from emergency spillways and from sediment pools to build the dams. Timber will be cleared from the dam sites and borrow areas as necessary to allow removal of borrow. Other clearing will be done as necessary to provide safe and functional operation and maintenance of the structure.

Modification of existing improvements at Structure Nos. 2 and 5 will be required. An entrance road, power line, and telephone line will be moved, and about 0.75 mile of township road will be closed at Structure No. 5. At Structure No. 2 a natural gas transmission line is scheduled to be replaced prior to project installation. The owners will modify the alignment and structure of the pipeline so there will be no conflict with the dam and pool.

Wildlife compensation measures adopted by the sponsors include 3 acres of woody plantings and 5 acres of herbaceous

plantings at Structure No. 1; and 3 acres of woody plantings and 4 acres of herbaceous plantings at each site for Structure Nos. 2 and 5. These plantings will be of native grasses, forbs, and trees.

Investigations by the Kansas State Historical Society, in consultation with the State Historic Preservation Officer and the Kansas State Archeologist, found that no known cultural resources will be adversely affected by the project. To avoid destruction of undetected cultural resources, Soil Conservation Service field personnel will be alerted to watch for signs of cultural resources during project construction. If items of archeological or historical interest are found, the Soil Conservation Service's procedures to implement compliance with regulations in executive orders for the protection of cultural properties will be followed to protect them.

The need for water and air pollution control during construction will be determined on a structure-by-structure basis. Control measures may include dry stream crossings, temporary vegetation, watering for dust control, controlled burning, and sediment basins.

A records search and field investigation by the Soil Conservation Service revealed no existing or abandoned oil wells at any structural site.

#### Operation and Maintenance

Landowners and operators will maintain land treatment measures on their farms under voluntary agreements with their conservation districts. Conservation district representatives will: periodically inspect land treatment measures; encourage landowners to perform needed maintenance; encourage rebuilding obsolete measures; and assist in planning new measures necessary to maintain adequate protection. As a part of technical assistance directed toward operation and maintenance of land treatment measures, the SCS will reaffirm the value of maintaining riparian habitat.

Agreements for operation and maintenance of structures, vegetative measures, and wildlife habitat compensation measures will be made between sponsors and the Soil Conservation Service before construction begins.

Maintenance of dams, reservoir areas, wildlife habitat compensation areas, and vegetation will be accomplished by Dry Creek Watershed Joint District No. 57 at an estimated annual cost of \$1,900. Operation will consist of controlling

the use of dam sites, reservoir areas, and wildlife compensation areas to be consistent with planned purposes. Maintenance will consist of repair and replacement of deteriorated elements of the installed structure and installation of additional appurtenances as may be required for the continued functional life of the dam, vegetation, and compensation area. Kinds of maintenance expected frequently are repairing fences, clearing debris, etc. Repairs to major items such as dams and spillways are expected infrequently. Maintenance of wildlife areas will be in accordance with a wildlife management plan developed by the sponsors and landowners in cooperation with the Soil Conservation Service. This plan may include preserving existing trees and shrubs, protecting planted areas, managing livestock use, mowing, and burning. Fences enclosing wildlife habitat compensation measures and the dam and emergency spillway area will be maintained. Technical assistance will be provided by the Soil Conservation Service.

Annual inspections will be made for the life of the project. Items inspected will include, but not be limited to: the principal spillway and its appurtenances, emergency spillway, earth fill, vegetative cover of the earth fill and emergency spillway, fences, and wildlife habitat measures. Records of inspection will be kept by the watershed district. The watershed district will provide access for official inspection of the structures at any time.

Dry Creek Watershed Joint District No. 57 will be responsible for maintaining drawdown control valves and passing natural streamflow through all structures to meet downstream water rights as provided by the Kansas Water Appropriation Act. The watershed district will drain sediment pools as necessary for operation and maintenance.

Access, other than for operation and maintenance, to all structures will be controlled by landowners. If recreational use of any site endangers public health, the watershed district will notify landowners that sanitary facilities should be installed. If the landowners do not provide facilities, the Kansas State Department of Health and Environment will be notified so that protection of public health will be insured.

The Soil Conservation Service, including an SCS engineer and the sponsors, will inspect these reservoirs immediately after the initial filling, annually during the first three years, after major storms or major earthquakes, and once every five years after the initial three-year period. The Soil Conservation Service (an SCS engineer is optional) and

sponsors will make a joint inspection once every two years after the initial three-year period.

The Kansas State Department of Health and Environment will provide technical assistance to the watershed district to recognize and to solve any problems that may develop concerning diseases associated with impounded water.

Technical assistance for maintaining fire control measures beyond the installation period will be provided by the State and Extension Forester, in cooperation with the Forest Service under regular continuing programs.

#### INSTALLATION COSTS - MONETARY

Structural measures costs are shown in Table 1. These costs are shown by individual structures in Table 2.

Construction costs of \$324,300 include direct costs for installation of floodwater retarding dams. Construction includes earth embankment, excavation, reinforced concrete, reinforced concrete pipe, wildlife habitat compensation plantings, seeding and planting, and fencing.

Engineering services costs of \$51,900 include surveys, geologic investigations, soil mechanics, structure designs, construction plans, and construction specifications.

The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (PL 91-646) requires payment of relocation costs for replacement housing, farming operations, and businesses in certain instances. Present studies show no person, business, or farm operation will be displaced.

Land rights costs of \$49,900 are for the right to install, operate, and maintain works of improvement. These rights include land purchases, easements, agreements, and road and utility modifications. Land values were estimated by Dry Creek Watershed Joint District No. 57 with Soil Conservation Service concurrence. Land rights cost estimates are based on current land values that vary from \$150 (woody pasture) to \$600 (cropland) per acre.

Project administration costs of \$129,500 include contract administration, securing permits for installation of improvements, review of engineering plans prepared by others, and construction inspection.

Cost sharing is shown in the agreement.

### ECONOMIC BENEFITS

Evaluated average annual project benefits are estimated at \$52,400. Individual items are shown in Tables 5 and 6.

Average annual flood reduction benefits within the watershed (shown in Table 5) will total \$28,500. Benefits to crops and pastures will average \$17,200 annually (60 percent of total benefits). Benefits to other agricultural properties such as stored feed, fences, buildings, and other farm facilities will average \$4,000 annually. Benefits to roads, bridges, and railroads will average \$4,100 annually.

Benefits from reduced flood plain scour will average \$400 annually. Indirect benefits, such as less interruption of travel on mail, school, and milk routes, will average \$2,800 annually. The reduction of the flood hazard will make possible annual benefits averaging \$4,700 from more intensive use of land through improved crop rotations and use of fertilizer.

Benefits of \$19,200 will occur annually to the Republican River flood plain outside the watershed.

### Benefit-Cost Comparison

Average annual cost of structural measures is \$40,100 (see Table 4). When the project is completely installed, the structural measures are expected to produce average annual benefits of \$52,400. The benefit-cost ratio is 1.3 to 1.0 (see Table 6).

### INSTALLATION AND FINANCING

Project installation will be completed in a 4-year period following authorization of federal assistance.

The following table shows anticipated cost, by fiscal year, for structural measures:

<u>Fiscal Year</u>	<u>P.L. 566 Costs</u>	<u>Other Costs</u>	<u>Total</u>
First	\$ 14,000	\$ 9,700	\$ 23,700
Second	326,000	30,600	356,600
Third	144,500	11,800	156,300
Fourth	18,200	800	19,000
Total	\$502,700	\$52,900	\$555,600

Conservation land treatment (see Table 1) will be installed by individual landowners or operators. Cost sharing through local, state, and federal programs will be used as available. The Soil Conservation Service will provide technical assistance. The Extension Service will assist the conservation districts in preparing general information for the educational phase of the land treatment program. The Farmers Home Administration soil and water loan program will be available. County Agricultural Stabilization and Conservation Committees will cooperate with the conservation districts to accelerate assistance for conservation practices.

The watershed district and conservation districts will encourage installation of land treatment measures necessary to assure that at least 50 percent of the land upstream from a floodwater retarding dam is adequately protected prior to construction of the dam.

At three separate watershed district board meetings, the Soil Conservation Service will present a program showing the value of maintaining riparian habitat. These presentations will occur before, during, and following construction. Sponsors will invite the Kansas Fish and Game Commission and Extension Service to participate.

During the construction phase the Soil Conservation Service will contact each flood plain landowner or operator to provide technical assistance in conserving and utilizing riparian woodland. Groups of landowners will be invited on field trips. The Soil Conservation Service will bear these technical service costs of \$5,000 through the going program. Local costs to be borne by the watershed district are expected to be minimal. Other costs will be borne by assisting agencies as part of their ongoing programs. Administration will be shared by landowners, and the watershed district, conservation districts, and the Soil Conservation Service. Each agency providing assistance will administer its own program.

Expenses of organizing the watershed district have been paid and current expenses are being met by an annual ad valorum tax. Sponsors' future expenses will be met with funds on hand and budgeted for the purpose, funds collected through taxes, and through issuance of general obligation bonds.

The watershed district has the necessary authority to finance and install watershed improvements. This includes

the right to accept contributions, levy taxes, make assessments against land specially benefited, issue bonds, and exercise the right of eminent domain. The district has agreed to use these powers as needed.

The Soil Conservation Service was requested by the sponsors to contract for construction of the floodwater retarding dams. Construction funds and engineering services will be provided by the Soil Conservation Service. Land rights will be provided by the watershed district. Contract administration will be accomplished by the Soil Conservation Service with assistance from the watershed district. Contract costs are expected to be all P.L. 566 costs and will be paid directly to the contractor by the Soil Conservation Service. Prior to installing works that obligate either sponsor or Soil Conservation Service funds, the sponsors and the Soil Conservation Service will enter into a project agreement.

Federal technical assistance, engineering services, project administration, and funds for construction are contingent upon appropriations for these purposes.

Construction will be started when necessary land treatment has been completed, land rights have been obtained, P.L. 566 funds are available, and the watershed district has obtained approval of construction plans and has necessary construction permits.

AGREEMENT

between the following local organizations:

Dry Creek Watershed Joint District No. 57  
Clay County Conservation District  
Cloud County Conservation District  
Republic County Conservation District  
Washington County Conservation District

(Referred to herein as Sponsors)

State of Kansas

and the

Soil Conservation Service  
United States Department of Agriculture

(Referred to herein as SCS)

Whereas, application has heretofore been made to the Secretary of Agriculture by local organizations for assistance in preparing a plan for works of improvement for Dry Creek Watershed, State of Kansas, under the authority of the Watershed Protection and Flood Prevention Act (16 U.S.C. 1001-1008); and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Soil Conservation Service (SCS); and

Whereas, there has been developed through the cooperative efforts of local organizations and SCS this plan for works of improvement for Dry Creek Watershed, State of Kansas:

Now, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through the SCS and the Sponsors hereby agree on this plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this watershed plan and including the following:

1. The Sponsors will acquire, with other than P.L. 566 funds, such land rights as will be needed in connection with the works of improvement (estimated cost \$49,900).

2. Dry Creek Watershed Joint District No. 57 assures that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsors and SCS as follows:

	<u>Sponsors</u> (Percent)	<u>SCS</u> (Percent)	<u>Estimated Relocation Payment Costs</u> (Dollars)
Relocation Payments	9.5	90.5	0*

\*Investigation has disclosed that under present conditions the project measures will not result in displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost shared in accordance with the percentages shown.

3. Dry Creek Watershed Joint District No. 57 will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works of improvement.

4. The percentages of construction costs to be paid by the Sponsors and by SCS are as follows:

<u>Works of Improvement</u>	<u>Sponsors</u> (Percent)	<u>SCS</u> (Percent)	<u>Estimated Construction Costs</u> (Dollars)
3 Floodwater Retarding Structures	0	100	324,300

5. The percentages of the engineering costs to be borne by the Sponsors and SCS are as follows:

<u>Works of Improvement</u>	<u>Sponsors</u> (Percent)	<u>SCS</u> (Percent)	<u>Estimated Engineering Costs</u> (Dollars)
3 Floodwater Retarding Structures	0	100	51,900

6. The Sponsors and SCS will each bear the costs of Project Administration which it incurs, estimated to be \$3,000 and \$126,500 respectively.

7. The Sponsors will obtain agreements from owners of not less than 50 percent of the land above each floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

8. The Sponsors will provide assistance to landowners and operators to assure the installation of land treatment measures shown in the watershed plan.

9. The Sponsors will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Sponsors will be responsible for the operation, maintenance, and replacement of works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this plan represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by SCS in carrying out the plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.

13. A separate agreement will be entered into between SCS and Sponsors before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

14. This plan may be amended, or revised, only by mutual agreement of the parties hereto except that SCS may deauthorize funding at any time it determines that the Sponsors have failed to comply with the conditions of this agreement. In this case, SCS shall promptly notify the Sponsors in writing of the determination and the reasons for the deauthorization of the project together with the effective date. Payments made to the Sponsors or recoveries by SCS shall be in accord with the legal rights and liabilities of the parties when project funding has been deauthorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between SCS and the Sponsors having specific responsibilities for the measure involved.

15. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this plan, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

16. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964, as amended, and the regulations of the Secretary of Agriculture (7 CFR 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any activity receiving federal financial assistance.

DRY CREEK WATERSHED JOINT  
DISTRICT NO. 57

By A. V. Ostlund  
A. V. Ostlund

Clyde, Kansas 66938  
Address Zip Code

Title President  
Date October 4, 1979

The signing of this plan was authorized by a resolution of the  
governing body of the DRY CREEK WATERSHED JOINT DISTRICT NO. 57

adopted at a meeting held on September 10, 1979

Clifford E. Ericson  
Clifford E. Ericson

Clyde, Kansas 66938  
Address Zip Code

Date October 4, 1979

CLAY COUNTY CONSERVATION  
DISTRICT

Box 38  
Clay Center, Ks. 67432

By Forrest W. Taddiken  
Forrest W. Taddiken

Address Zip Code

Title Chairman  
Date October 24, 1979

The signing of this plan was authorized by a resolution of the  
governing body of the CLAY COUNTY CONSERVATION DISTRICT

adopted at a meeting held on

October 24, 1979

Roy M. Anderson  
Roy M. Anderson

R.R. #4 Clay Center, Ks. 67432  
Address Zip Code

Date October 24, 1979

CLOUD COUNTY CONSERVATION  
DISTRICT

Box 567  
Concordia, Kansas 66901  
Address Zip Code

By Carl M. Swenson  
Carl M. Swenson

Title Chairman  
Date October 10, 1979

The signing of this plan was authorized by a resolution of the  
governing body of the CLOUD COUNTY CONSERVATION DISTRICT

adopted at a meeting held on October 10, 1979

Marguerite B. Erickson  
Marguerite B. Erickson, Sec.

Concordia, Kansas 66901  
Address Zip Code

Date October 10, 1979

REPUBLIC COUNTY CONSERVATION  
DISTRICT

Box 445  
Belleville, Kansas 66935  
Address Zip Code

By Glen O. Starnad  
Glen O. Starnad

Title Chairman  
Date October 29, 1979

The signing of this plan was authorized by a resolution of the  
governing body of the REPUBLIC COUNTY CONSERVATION DISTRICT

adopted at a meeting held on October 29, 1979

Joyce Davenport  
Joyce Davenport, Secretary

Belleville, Kansas 66935  
Address Zip Code

Date October 29, 1979

WASHINGTON COUNTY CONSERVATION  
DISTRICT

Box 231, Washington, Kansas 66968  
Address Zip Code

By Herbert Meyerhoff  
Herbert Meyerhoff

Title Chairman

Date October 10, 1979

The signing of this plan was authorized by a resolution of the  
governing body of the WASHINGTON COUNTY CONSERVATION DISTRICT  
adopted at a meeting held on October 10, 1979

Katherine E. Matson  
Katherine E. Matson, Sec.

Washington, Kansas 66968  
Address Zip Code

Date October 10, 1979

Appropriate and careful consideration has been given to the  
environmental assessment for this project and to the  
environmental aspects thereof.

Soil Conservation Service  
United States Department of Agriculture

Approved by:

John W. Tippie  
John W. Tippie  
State Conservationist

Date 11/3/79



TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Dry Creek Watershed, Kansas

Installation Cost Item	Unit	Number	Estimated Cost Dollars a/				
			P. L. 566 Funds		Other		Total
			Non-Fed. Land	SCS c/ SCS c/	Non-Federal Land	SCS c/	
LAND TREATMENT-GOING PROGRAM							
Land Areas b/							
Cropland		800			16,000	16,000	16,000
Grassland		200			2,000	2,000	2,000
Riparian woodland		170			( 5,000)c/	( 5,000)	( 5,000)
Technical Assistance					7,900	7,900	7,900
TOTAL LAND TREATMENT		1,170			25,900	25,900	25,900
STRUCTURAL MEASURES							
Construction d/							
Floodwater Retarding Structures	Number	3	324,300	324,300			324,300
Engineering Services			51,900	51,900			51,900
Land Rights					49,900	49,900	49,900
SUBTOTAL STRUCTURAL MEASURES			376,200	376,200	49,900	49,900	426,100
Project Administration							
Construction Inspection			94,100	94,100			94,100
Other			32,400	32,400	3,000	3,000	35,400
SUBTOTAL-ADMINISTRATION			126,500	126,500	3,000	3,000	129,500
TOTAL STRUCTURAL MEASURES			502,700	502,700	52,900	52,900	555,600
TOTAL ALL COSTS			502,700	502,700	78,800	78,800	581,500

a/ Price Base 1978.

b/ Includes only areas estimated to be adequately protected during the installation period. Treatment will be applied throughout the watershed and dollar amounts apply to total land areas, not just to adequately protected areas.

c/ Federal agency responsible for assisting in installation of works of improvement.

d/ Includes wildlife habitat mitigation costs for woody and herbaceous plantings: \$4,000 at No. 1, \$3,900 at No. 2, and \$3,900 at No. 5.

e/ Technical assistance to encourage riparian habitat preservation and enhancement.

July 1979

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT  
(At Time of Plan Preparation)

Dry Creek Watershed, Kansas

Measures	Unit	Applied <sup>b/</sup> to Date	Total Cost (Dollars) <sup>a/</sup>
<u>LAND TREATMENT</u>			
<u>Soil Conservation Service</u>			
Conservation cropping system	Ac.	4,470	13,400
Diversions	Mi.	4	6,000
Farm ponds	No.	16	24,000
Grassed waterway	Ac.	150	67,900
Terrace (gradient)	Mi.	87	92,000
Proper grazing use	Ac.	2,900	7,300
Land adequately treated	Ac.	10,718	---
<u>Forest Service</u>			
Fire protection	Ac.	5,571	3,200
<b>TOTAL</b>			
			213,800

a/ Price base 1978

b/ October 1, 1976

July 1979

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION  
 Dry Creek Watershed, Kansas  
 (Dollars)<sup>a/</sup>

Item	Installation Cost P.L. 566 Funds			Installation Cost - Other Funds			Total Installation Cost
	Construction	Engineering	Total Rights P.L.	Construction	Engineering	Total Other	
Floodwater Retarding Structure							
No. 1	128,900	20,600	—	149,500	—	—	164,800
No. 2	82,400	13,200	—	95,600	—	—	109,900
No. 5	113,000	18,100	—	131,100	—	—	151,400
Subtotal - FRS	324,300	51,900	—	376,200	—	—	426,100
Project Administration	—	—	—	126,500	—	—	3,000
GRAND TOTAL	324,300	51,900	—	502,700	—	—	555,600

<sup>a/</sup> Price base 1978.

<sup>b/</sup> Includes land cost only. A natural gas transmission line that would require relocation is scheduled for replacement by the owner regardless of project action. An agreement to reroute the gas line to avoid conflict has been consummated between sponsors and the owner. There will be no cost to project sponsors.

<sup>c/</sup> Includes \$6,900 to modify a farmstead entrance, move a powerline, and move a telephone line.

Dry Creek Watershed, Kansas

ITEM	UNIT	STRUCTURE NUMBER			TOTAL
		1	2	5	
Class of Structure					
Drainage Area	Sq. Mi.	4.41	3.02	2.60	10.03
Uncontrolled		77	77	77	
Curve No. (1-day)(AMC II)					
Time of Concentration (Tc)	Hours	1.3	1.1	1.4	
Elevation Top of Dam	Feet (MSL)	1,427.6	1,416.4	1,372.3	
Elevation Crest Emergency					
Spillway	Feet "	1,422.6	1,411.4	1,367.3	
Elevation Crest Inlet	Feet "	1,411.0	1,402.8	1,358.8	
Maximum Height of Dam	Feet	36	33	28	
Volume of Fill	cu. Yds.	73,200	41,100	63,000	
Total Capacity a/					177,300
Sediment Submerged	Ac. Ft.	834	551	475	1,860
Sediment Aerated	Ac. Ft.	157	108	96	361
Retarding	Ac. Ft.	19	12	11	42
Surface Area	Acres	658	431	368	1,457
Sediment Pool	Acres	30	26	26	82
Retarding Pool	Acres	93	77	67	237
Principal Spillway Design					
Rainfall Volume (1 day)	Inches	5.45	5.45	5.45	
Rainfall Volume (10 day)	Inches	8.80	8.80	8.80	
Runoff Volume (10 day)	Inches	3.96	3.96	3.96	
Capacity (Max.)	c.f.s.	34	34	31	
Frequency Operation -					
Emergency Spillway	% Chance	4	4	4	
Dimensions of Conduit	Inches	18	18	18	
Emergency Spillway Design					
Rainfall Volume (1 day)	Inches	5.35	5.35	5.35	
Rainfall Volume (10 day)	Inches	2.91	2.91	2.91	
Runoff Volume	Hours	6	6	6	
Storm Duration					
Type					
Bottom Width	Feet	40	40	40	
Velocity of Flow (Ve)	ft./sec.	2.00	1.96	1.80	
Slope of Exit Channel	ft./ft.	.04	.04	.04	
Maximum Reservoir Water	Feet (MSL)	1,422.9	1,411.8	1,367.6	
Surface Elevation					
Freeboard Design					
Rainfall Volume	Inches	7.85	7.85	7.85	
Runoff Volume	Inches	5.13	5.13	5.13	
Storm Duration	Hours	6	6	6	
Maximum Reservoir Water	Feet (MSL)	1,426.3	1,414.9	1,370.5	
Surfacc Elevation					
Capacity Equivalents					
Sediment Volume	Inches	0.75	0.74	0.77	
Retarding Volume	Inches	2.80	2.67	2.65	

a/ At emergency spillway crest elevation

July 1979

TABLE 4 - ANNUAL COST

Dry Creek Watershed, Kansas  
(Dollars) <sup>a/</sup>

Evaluation Unit	Amortization of Installation Cost <sup>b/</sup>	Operation and Maintenance Cost	Total
3 Floodwater Retarding Structures	29,300	1,900	31,200
Project Administration	8,900	—	8,900
GRAND TOTAL	38,200	1,900	40,100

<sup>a/</sup> Price base 1978

<sup>b/</sup> 100 years at 6-7/8 percent interest

July 1979

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE  
REDUCTION BENEFITS

Dry Creek Watershed, Kansas

(Dollars)<sup>a/</sup>

Item	Estimated Average Annual Damage		Damage Reduction Benefits within the Watershed
	Without Project	With Project	Structural Measures
Floodwater			
Crop and pasture	23,600	6,400	17,200
Other agricultural	4,500	500	4,000
Non-agricultural			
Road and bridge	2,900	300	2,600
Railroad	1,900	400	1,500
Subtotal	32,900	7,600	25,300
Erosion			
Flood plain scour	600	200	400
Indirect	3,600	800	2,800
Subtotal	37,100	8,600	28,500

Item	Estimated Average Annual Damage		Damage Reduction Benefits to Republican River Prop- erties outside the Water- shed
	Without Project	With Project	Structural Measures
Floodwater			
Crop and pasture	26,900	10,400	16,500
Other agricultural	1,300	300	1,000
Subtotal	28,200	10,700	17,500
Indirect	2,800	1,100	1,700
Subtotal	31,000	11,800	19,200

GRAND TOTAL	68,100	20,400	47,700
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a/ Price base: Agricultural production is current normalized (Oct. 1978), all other is current 1978.

TABLE 6 - COMPARISON OF BENEFITS AND COSTS  
Dry Creek Watershed, Kansas  
(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS <sup>a/</sup>			Average Annual Costs <sup>c/</sup>	Benefit Cost Ratio
	Damage Reduction <sup>b/</sup>	More Intensive Land Use	Total		
3 Floodwater Retarding Structures	47,700	4,700	52,400	31,200	1.7:1
Project Administration				8,900	
GRAND TOTAL	47,700	4,700	52,400	40,100	1.3:1

<sup>a/</sup> Price Base: Agricultural production current normalized (WRC - October 1978); other items 1978 prices  
<sup>b/</sup> From Table 5  
<sup>c/</sup> From Table 4

July 1979



APPENDICES

Appendix A - Technical Appendix

Appendix B - Display Accounts for Selected Alternative

Appendix C - Summary Comparison of Alternative Plans

Appendix D - Earth Dam With Drop Inlet Spillway

Appendix E - Project Map



APPENDIX A

Technical Appendix

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## INTRODUCTION

Dry Creek, a left bank tributary to the Republican River, drains a watershed of 15,232 acres (23.8 square miles).<sup>1/</sup>\* From headwaters about 2 miles north of Brantford, an unincorporated community in the watershed, Dry Creek flows south about 13 miles to the Republican River. The Republican River is a subwatershed in the Kansas River Basin in Kansas. (Water Resources Council hydrologic code 10250017.) This project is an element of the Missouri River Basin Commission's Comprehensive Coordinated Joint Plan (August 1977).

Population in Dry Creek Watershed was 194 in 1960 but had dropped to 160 by 1970. If this trend continues, the year 2000 watershed population will be about 85. There are no incorporated cities within the watershed. Total population for 1970 in Clay, Cloud, Republic, and Washington Counties was 41,103: urban, 25,543 and rural, 15,560.<sup>2/</sup>

Dry Creek Watershed has a typical continental subhumid climate: hot summers, cold winters, sudden temperature changes in all seasons, and great variability of precipitation. Annual precipitation averages about 26 inches. Maximum annual precipitation in the watershed vicinity was 40.76 inches recorded at Concordia (18 miles west of the watershed) in 1951. Approximately 75 percent of all precipitation falls between April 1 and October 31. Brisk winds are common during spring and fall. Mean temperature is about 53° F. The growing season averages about 170 days.<sup>3/</sup>

Upland soils in the watershed are classified predominantly in Land Use Capability Classes II, III, and IV. These classes are properly used for cropland when protected from erosion. They were formed from sandstone, shale, limestone, and loess. Upland soils belong to the Crete-Hastings-Geary, Lancaster-Hedville-Crete, and Kipson-Armo-Crete associations. Soils are loamy and clayey, gently sloping to rolling, and deep to shallow. Crete soils occur on the broad smooth hilltops; Hastings soils occur on the steeper side slopes. Kipson soils are on the slopes below the Hastings soils, and Breaks Alluvial Land complex occurs along the deeply entrenched streams. Lancaster soils occur with the Hastings soils on the lower slopes and on some low lying hills in the valleys.

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\*See list of references

Soils in the valleys are in the Carr-Muir-Hord association. These soils are nearly level to gently undulating. They were formed in silty alluvium, are occasionally flooded, and are well drained.

Soil surveys are completed and published for Cloud and Republic Counties.

SETTING, PROBLEMS, AND IMPACT

Land Resources

Dry Creek Watershed is a long narrow watershed. The upper reaches are rolling crop and pastureland. The lower reaches are very flat flood plain of crop and pastureland with a narrow band of rolling hills along each side.

More than 97 percent of the watershed is used for agricultural production. Land use and major crops grown in the watershed are displayed in Table A.

TABLE A

Estimated Land Use and Major Crops - 1976  
(Acres)

	<u>Flood Plain</u>	<u>Upland</u>	<u>Total</u>
Cropland			
Wheat	312	3,800	4,112
Sorghum Grain	315	3,451	3,766
Corn Grain	337	480	817
Soybeans	41	36	77
Alfalfa	26	863	889
Subtotal	1,031	8,630	9,661
Pastureland	150	799	949
Rangeland	98	3,099	3,197
Upland Woodland	--	6	6
Riparian Woodland	172	542*	714
Miscellaneous	29	316	345
Water	142	218	360
Total	1,622	13,610	15,232

\*This woodland is located above the proposed sites and benefited area along small tributaries.

Climax vegetation in Dry Creek Watershed is dominated by big and little bluestem, indiangrass, and switchgrass. This community is the mix of plants best adapted to the area. They are also the most productive without tillage, fertilizers, pesticides, or irrigation. Domestic crops are more productive than native vegetation when properly managed. Table B shows current, projected, and potential crop yields.

Table B

Current and Projected Crop Yields

Crop	Yield Units	Flood Plain		Upland	
		1976 (Flood Free)	Potential* (Flood Free)	1976	Potential
Wheat	Bu./Ac.	54	65	37	60
Grain Sorghum	Bu./Ac.	96	150	65	120
Sorghum Silage	Ton/Ac.	20	35	13	25
Grain Corn	Bu./Ac.	73	150	61	140
Soybeans	Bu./Ac.	42	60	20	50
Alfalfa	Tons/Ac.	6.2	7.5	2.7	6.5
Wild Hay	Tons/Ac.	1.5	2.0	1.0	1.5

\*Year 2000

Upland erosion and damages on the flood plain to growing crops, pasture, roads, bridges, railroads, and other agricultural facilities are the principal problems. Sediment has nearly filled the Dry Creek channel in some places. In the lower reaches of the flood plain water flows out of the stream channel creating wide shallow scour channels which pick up sediment and deliver it to the Republican River.

Erosion is a greater problem on cropland than on pastureland, and on pastureland than on rangeland. In Dry Creek Watershed about 46,000 tons of soil are eroded annually. Average sheet erosion in the watershed is 3 tons per acre per year. Soil loss on unprotected cropland can exceed 15 tons per acre per year in the watershed. Sheet erosion on upland cropland is the most serious land-depleting problem. Table C summarizes present watershed soil loss.

Table C

Present Average Annual Watershed Soil Loss (Erosion)

Type	Land Use	Acres	Average tons/Ac	Tons
<b>Upland</b>				
Sheet	Cropland	8,630	3.8	33,200
Gully	Various	145	25.0	3,600
Streambank		9	80.0	720
Stream channel		64	--	--
Sheet	Grassland	3,898	0.9	3,500
	Riparian Woodland	548*	1.5	800
	Misc.	316	3.8	1,200
<b>Bottomland</b>				
Sheet		1,448	1.3	1,900
Scour		32	18.8	600
Streambank		6	80.0	480
Stream channel		136	--	--
<b>Totals</b>		<b>15,232</b>		<b>46,000</b>

Erosion decreases productivity and diminishes land value. Measures installed during the project period will reduce erosion, and subsequently soil depletion. Results will be maintenance of land value and enhanced production.

Table D

Annual Watershed Soil Loss (Erosion) With Project

Type	Land Use	Acres	Average tons/Ac	Tons
<b>Upland</b>				
Sheet	Cropland	8,665	3.4	29,100
Gully	Various	110	2.0	2,800
Streambank		9	80.0	720
Stream channel		64	--	--
Sheet	Grassland	3,898	0.8	3,100
	Riparian Woodland	548*	1.5	800
	Misc.	316	3.8	1,200
<b>Bottomland</b>				
Sheet		1,455	1.3	1,900
Scour		25	20.0	500
Streambank		6	80.0	480
Stream channel		136	--	--
<b>Totals</b>		<b>15,232</b>		<b>40,600</b>

\*Includes 6 acres of Upland Woodland.

Flood plain scour is a problem in the lower reaches of Dry Creek. Agricultural production is reduced by 10 to 18 percent on about 32 acres. Scour rate on this area is about 20 tons per acre per year. The project will reduce the area damaged by flood plain scour to about 25 acres.

Damage from sediment deposition on Dry Creek flood plain is not permanent. To incorporate the sediment into the soil requires time and energy, but this was not evaluated. In-channel sediment deposition is a problem at some points on Dry Creek. Five acres of floodway have been filled, or are filling with sediment. Deposition rates are about 0.2 to 0.4 feet per year. Cost of removal of this sediment is a landowner/operator cost that was not evaluated.

Presently 10,718 acres of upland and flood plain are adequately protected from erosion, 4,122 acres are unprotected farmland, 145 acres are gullies, 215 acres are stream channel and stream bank, and 32 acres are farmed scour channels. Runoff from the watershed carries about 11,500 tons of sediment to the Republican River annually.

Following completion of the project, about 11,718 acres of upland and flood plain will be adequately protected from erosion 110 acres will be gullies, 215 acres will be stream channel and bank, and 25 acres will be farmed scour channel.

The going land treatment program alone will reduce soil loss to about 40,600 tons annually and sediment yield to the Republican River to about 10,200 tons annually. The three floodwater retarding dams with the conservation land treatment program will reduce sediment delivered to the Republican River to 6,400 tons annually.

Floodwater retarding dams and pools will require land use changes as shown in Table E.

Table E  
Land Use at Structure Sites

	Present Land Use (acres)				
	Crop- land	Grass- land	Forest- land	Other	Total
Sediment Pools	5	52	24	1	82
Detention Pools	26	107	21	1	155
Dams and Spillways	5	4	3	1	13
Total	36	163	48	3	250

Presently there are 10,440 acres classified as prime farmland in the watershed. About 9,410 acres are located on the upland and 1,030 acres are located on the flood plain. Prime farmland in the watershed will remain constant without a floodwater retarding project.

The floodwater retarding dams and pools will require 250 acres on which agricultural production will be lost or reduced. As a result 178 of these 250 acres will no longer have the production potential to be classified as prime farmland.

There are presently 1,480 acres in the 100-year watershed flood plain. The entire flood plain is located downstream from the floodwater retarding dams. All of the flood plain has the production potential to be classified as prime farmland. However, land which is flooded more often than once every two years cannot be so classified.

Presently there are 420 acres flooded at least once every two years. Installing the project will reduce this area to 80 acres. As a result 340 acres of flood plain will be reclassified as prime farmland. A net increase of 162 acres of prime farmland will result.

#### Water Resources

The average annual runoff from Dry Creek Watershed is about 2.5 inches.<sup>4/</sup> Streamflow is greatest during summer, when the area receives 75 percent of its average annual precipitation. There are 28.9 miles of intermittent stream and 25.8 miles of ephemeral stream in the watershed. Discharge reductions and flood frequencies are shown in Table F.

Table F  
Peak Discharge Reductions and Flood Frequencies

Reach	Location	Percent Peak Reduction	Average Flood w/o Project	Frequency w/Project
0-1	South of Clifton	38	3 times/year	2 times/year
0-3	Dry Creek Outlet	63	2 times/year	1 time/year
2	In vicinity of Highway K-9	68	3 times/2 years	2 times/3 years
3A	3 to 4 miles north of Highway K-9	79	1 time/year	1 time/4 years
3C	6 to 7 miles north of Highway K-9	88	1 time/year	1 time/10 years

The project will reduce storm discharge peaks prolonging the period of total discharge and low flows.

Water quality samples and flow measurements were taken at two sites within the watershed during the environmental assessment. Fecal coliform may exceed maximum criteria for Kansas class B streams during high flows.5/ This is a common water quality problem in Kansas.

Insecticides commonly used in the watershed are Thimet, Parathion, and Di-syston. They are short-lived and not of major concern in the environment. Pesticide tests made in 1976 showed concentrations well below Food and Drug Administration Guidelines.6/ 7/

Many pesticides and some nutrients are transported by sediment in surface runoff. Project effects of reducing erosion, reducing sediment yield, and slowing runoff will reduce the volume of chemicals reaching streams. Chemicals carried by soil particles will be trapped in sediment pools. Water soluble chemicals reaching the structures will be diluted, pass through the structures, and remain in downstream flow.

Dams and sediment pools will cover 2.5 miles of intermittent stream and initially provide 82 acres of impounded water. The project will not change stream flow classifications.

#### Biological Resources

Terrestrial wildlife in the watershed is highly diversified. Lack of water is the main factor limiting aquatic wildlife.

An aquatic habitat evaluation was made by the Kansas Fish and Game Commission. Factors other than lack of water that are reducing aquatic habitat quality are suspended sediment and excessive nutrients. The only natural fishery in the area is the Republican River.

Streamflow at structure sites is presently insufficient to support fish. Greater flow durations and seepage from reservoirs will increase base flows. Streamflow downstream from reservoirs will be more stable, but still insufficient to support fish.

The three sediment pools will initially provide 82 acres of warm water reservoir and 6.6 miles of shoreline.

These pools will have sufficient water depth and surface area to support an incidental fishery for part of the project life. Public use is unlikely.

Project effect on wildlife is measured in wildlife habitat units. Habitat units are a measure of how well existing vegetation meets wildlife needs. A quality rating of ten is excellent and one is poor. Net habitat units are derived by multiplying rated value by the acres in the area rated.

Wildlife habitat now in the watershed consists of about 45,900 units of herbaceous habitat, 3,700 units of woodland habitat, and 1,200 units of terrestrial stream habitat. Wildlife habitat destroyed by the project before compensation will be 371 units of herbaceous habitat, 89 units of woodland habitat, and 67 units of terrestrial stream habitat.

Project compensation will replace 130 units of herbaceous habitat and 90 units of woodland habitat. Herbaceous habitat is dispersed throughout the watershed. The project compensation plan will replace enough herbaceous habitat destroyed by the project to maintain continuity of this resource. Compensation or replacement will be made for all destroyed woodland habitat. Some terrestrial stream habitat will be covered by water and replaced by aquatic and shoreline habitat.

Aquatic and riparian habitat along 2.5 miles of intermittent stream at the structure sites will be covered by sediment pools. These pools will create 82 acres of aquatic habitat and 6.6 miles of shoreline.

Dams, spillways, and sediment pools will replace 27 acres of woodland. Nine acres of cropland will be planted to trees to compensate for the wildlife habitat losses. Sponsors will manage these converted acres to optimize wildlife habitat. About 700 acres of riparian woodland will occur in the watershed after the project installation period.

Owners and/or operators of the 170 acres of riparian woodland on the flood plain will be given several opportunities to become aware of the value wildlife is to them and how critical remaining riparian woodland is to wildlife. Owners and/or operators of other woodland in the watershed will have opportunities to attend annual meetings and receive the same information.

Changes in wildlife habitat with the project installed are summarized in Table G.

Table G

Wildlife Habitat Changes

<u>Habitat Units Lost</u>	Structure		
	<u>1</u>	<u>2</u>	<u>5</u>
Woodland	47	7	35
Herbaceous	131	140	100
Stream Terrestrial	46	10	11
<u>Habitat Units Gained*</u>			
	30	30	30
Woodland	30	30	30
Herbaceous	50	40	40
Stream Terrestrial	0	0	0
<u>Acres Needed</u>			
	3	3	3
Woodland	3	3	3
Herbaceous	5	4	4
Stream Terrestrial	0	0	0
<u>Habitat Units Net Change</u>			
	-17	+ 23	- 5
Woodland	-17	+ 23	- 5
Herbaceous	-81	-100	-60
Stream Terrestrial	-46	- 10	-11

\*Guidance for replacing wildlife habitat will be found in the Dry Creek wildlife habitat compensation plan.

There are no nationally threatened or endangered species<sup>8/</sup> that are likely to reside in the watershed area. The whooping crane, bald eagle, and peregrine falcon could pass through the area. A triagency biological assessment conducted for the watershed during July 1976, concluded the project action would have no effect on any of the above species. Additional species listed as state threatened species<sup>9/</sup> could also pass through the watershed area. These state listed species include the prairie falcon and least tern.

Economic Resources

The major impacts are economic gains to agricultural interests from reduction of flood damages.

Agricultural production will be reduced from areas required for structural installation. However, reliable productivity will increase in other areas. Total project impact on agricultural production will be to increase

production by 13 percent on 1,480 acres that will be protected from flooding below structures. Additional protection will be provided 1,280 acres of flood plain common with the Republican River.

Flooding often occurs more than twice a year in the watershed (see Table F). Flooding has occurred in every month, but 87 percent of all floods occur during the growing season. A one-year frequency flood will cause about \$8,100 damage and a large infrequent flood (10-year frequency) will cause about \$70,500 damage.

Potential annual crop and pasture income on the flood plain amounts to \$277,700 based on current normalized prices released by the Water Resources Council, October, 1978. Frequent flooding is an important factor keeping farmers from realizing this potential. Actual income based on the above prices without flood control amounts to \$254,100.

The following table shows acres flooded by frequency at depths of zero to two feet and greater than two feet:

Table H

Acres Presently Flooded by Reach by Depth by Frequency

Depth	Reach <sup>a/</sup>	Units	Feet	100-Year Flood Plain	Frequency (years)			
					100		4	
					0-2	2+	0-2	2+
1A	Acres	186		135	51	--	--	--
1B	Acres	228		150	78	69	--	27
2	Acres	557		125	432	308	46	95
3A	Acres	194		84	110	65	36	19
3B	Acres	169		67	102	46	30	32
3C	Acres	48		23	25	9	7	3
3D	Acres	98		20	78	23	24	10
Total	Acres	1,480		604	876	520	143	186
								1

a/ See Project Map (Appendix E) for reach locations.

Floodwater damage has been extensive on agricultural land in the flood plain. The major damage is to growing crops and forage grasses. Floods that occur before or

shortly after fields have been planted cause extra tillage and reseeding. Floods usually last less than 24 hours. Watershed crop and pasture damage now averages \$23,600 annually. After project installation, these losses will be reduced to \$6,400.

Fences, machinery, livestock pens, feed bunks, water wells, and stockwater tanks are frequently damaged on 25 farms using the flood plain. Five farmsteads have out-buildings on the flood plain. These other agricultural damages now average \$4,500 annually. Damages will average \$500 annually with the project.

Floods erode road and railroad surfacing and shoulders, fill ditches with sediment, and damage bridges. There are 12 bridges, 2 miles of road, 2 railroad bridges, and 1 mile of railroad subject to damage in the watershed. About 1.1 miles of gravel, 0.3 mile of asphalt, 0.6 mile of dirt road, and 1 mile of railroad are located on the flood plain. County and township budgets are not sufficient to make timely replacements and repairs after a flood, hence these essential facilities remain in poor condition. Floodwater damage to roads, railroads, and bridges averages \$4,800 annually without the project or \$700 with the project.

Flooding indirectly affects everyone in the area due to loss of use of utilities and transportation systems. Such indirect losses average \$3,600 annually without the project, or \$800 with the project.

Dry Creek damages on the 1,280 acres of flood plain common with the Republican River will be reduced from \$31,000 to \$11,800 annually.

#### Visual Resources

Land treatment will change the appearance of the landscape by reducing gullies and rill erosion, and by increasing diversity with grassed waterways, ponds, and other vegetative practices. Floodwater retarding reservoirs will increase landscape diversity.

Construction will destroy some riparian vegetation which now provides diversity to the landscape. Water in the sediment pools and wildlife plantings will add to visual diversity. Spoil placement and plantings will be planned to blend with their surroundings.

Dust, sediment, smoke, and noise will temporarily increase during construction.

### Social Resources

Social effects of the project are expected to be positive.

Agriculture provides the only employment in the watershed<sup>10/</sup>. Little, if any, of the 4.9 man years of employment needed for project installation is likely to go to watershed residents.

The 1969 median family income for Washington County was \$6,111. In the same year Kansas median family income was \$8,690 and national median family income was \$9,586<sup>11/</sup> 12/.

The percentage distribution of Washington County family income in 1969 was 18 percent, less than \$3,000; 56 percent, \$3,000 to \$10,000; and 26 percent, greater than \$10,000. At the same time Kansas family income distribution was 11 percent, less than \$3,000; 49 percent \$3,000 to \$10,000; and 40 percent, greater than \$10,000.

Median family income will continue to increase in the area. If the project is installed, income will increase slightly faster in the watershed.

Landowners and operators of protected flood plain land will be able to increase the efficiency of their operation. All watershed residents and some adjacent residents will benefit from the project. Some of these benefits include better roads and increased returns from agricultural production.

Consideration has been given to possible damage downstream from each floodwater retarding dam in case of sudden failure or breaching. The probability of failure is minimal. If failure did occur, damages would be confined to agricultural land, fences, and township or county roads. No potential threat of loss of human life presently exists due to a failure, but could occur if inappropriate developments are built downstream from floodwater retarding dams.

### Cultural Resources

The Kansas State Historical Society, under the direction of the State Historic Preservation Officer, conducted investigations in the watershed to assess archeological, architectural, historic, and unique scenic resources<sup>13/</sup> 14/. This study found no resources that would be disturbed by installation of the project<sup>15/</sup> 16/.

UNAVOIDABLE ADVERSE IMPACTS

The following adverse impacts will result from project installation:

1. Removal of 95 acres from agricultural production.
2. Net loss of 67 units of terrestrial stream habitat, and 241 units of herbaceous habitat.
3. Reduction of agricultural production and wildlife use on 155 acres.
4. Inundation of 2.5 miles of intermittent stream.
5. Temporary increase of dust, smoke, sediment, and noise at construction sites.

ALTERNATIVES

There are no alternatives to the selected plan which will achieve planning objectives without a similar commitment of resources and environmental impacts. However, several alternatives to the selected plan were considered during planning. They include allowing present trends to continue without a project, installing an accelerated land treatment program only, and installing several combinations of floodwater retarding dams with or without accelerated land treatment. An incremental analysis was made of several structures to provide the basis for formulating the NED Plan.

The selected plan consists of the wildlife education program from the Environmental Quality (EQ) plan, and floodwater retarding elements from the National Economic Development (NED) plan (Structure Nos. 1 and 2). Floodwater retarding Structure No. 5 is also a part of the selected plan. Structure No. 5 is a part of the selected system because of its contribution to floodwater damage reduction objectives. Construction of Structure No. 5, in conjunction with 1 and 2, would increase overall flood damage reduction from 57 percent to 76 percent. Increased prime farmland and reduction of areas flooded were major considerations for including Structure No. 5 as part of the selected system. The following table displays data considered as part of the selection process:

<u>Item</u>	<u>Without Project</u>	<u>Structures 1 &amp; 2</u>	<u>Structures 1, 2, &amp; 5</u>	<u>Contri- bution by Str. 5</u>
<u>On-project effect</u> - - - - - acres - - - - -				
Prime farmland	1,030	1,295	1,370	75
2-year area flooded	436	158	82	76
10-year area flooded	1,000	600	418	182
100-year area flooded	1,480	986	817	169
<u>Off-project effect</u>				
Prime farmland	839	969	990	21
2-year area flooded	429	296	275	21
10-year area flooded	906	668	602	66
100-year area flooded	1,285	1,102	1,012	90

Other considerations for including Structure No. 5 include its impact on transportation of farm products, school children, and mail. Two all-weather roads, Highways 9 and 148, cross the watershed. These roads are connected by gravel and dirt roads within the watershed. Maintenance of these rural roads is critical to rural transportation. Several bridges below Structure No. 5 need repair. With Structure Nos. 1, 2, and 5, several downstream bridges will probably be replaced by culverts at a substantial cost savings to the county road department. These savings have not been included as part of the NED benefits.

Other floodwater retarding dams considered were Structure Nos. 3, 4, 5A, and 6 (see Figure 1). Structure No. 3 is located just downstream from 1 and 2 and is an alternative to 1 and 2. Physical conflicts made Structure No. 3 more costly than 1 and 2. Structure No. 5A is an alternative to 5. Structure No. 5 was preferred because it controls a larger drainage area and provides greater flood protection downstream. Structure Nos. 4 and 6 are mainstem structures. Structure No. 4 is an alternative to building either 1 and 2, or 3. Structure No. 4 lies on the flood plain and is a shallow site. It was not selected because it would cover a large area and has several physical conflicts. Structure No. 6 is located farther downstream than the others and

could be built alone or in combination with any other except Structure No. 5 (see location map).

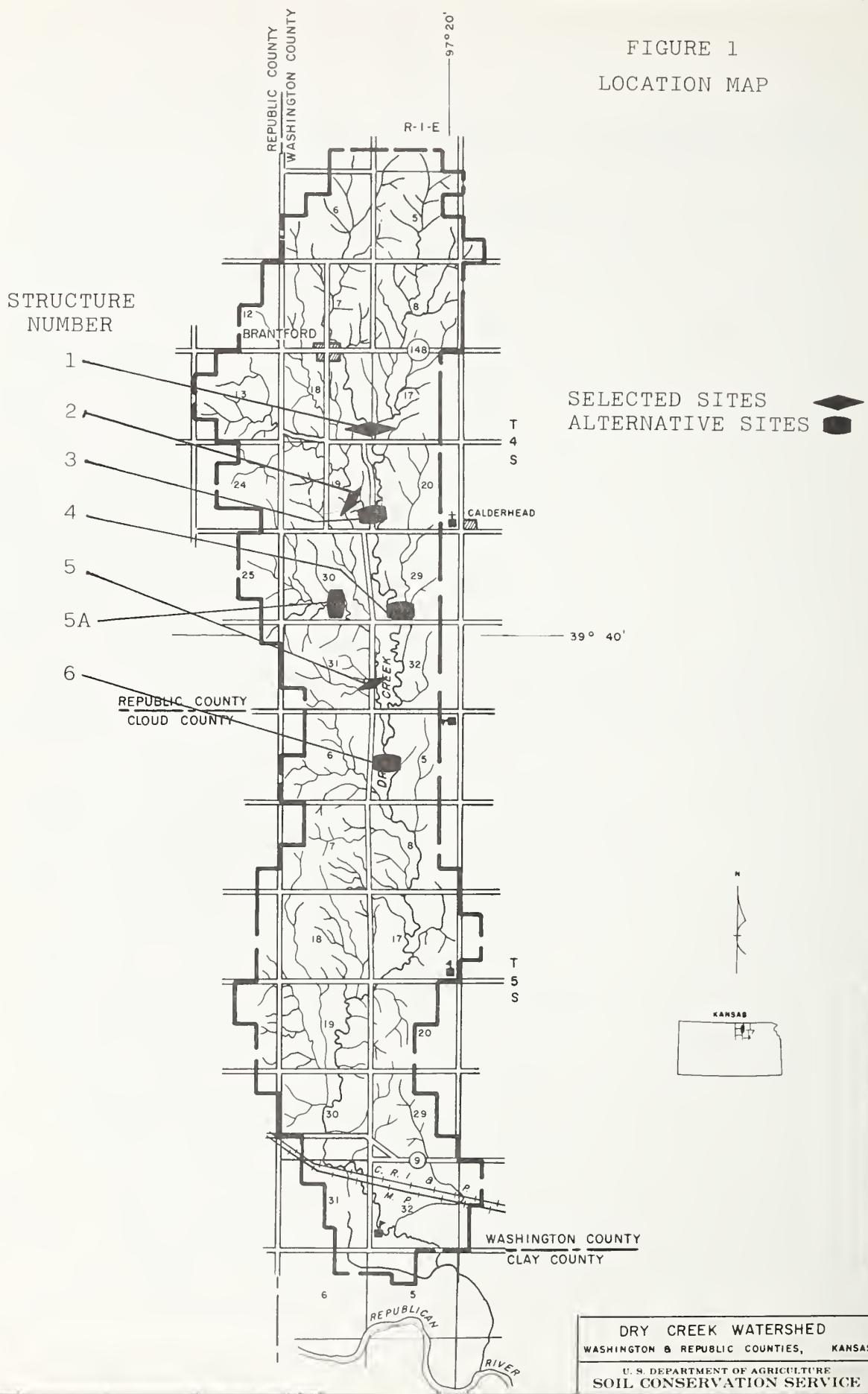
Consideration was given to accelerating the ongoing conservation land treatment program as part of the project. The sponsors have set a goal to complete 90 percent of the needed land treatment in the watershed. The ongoing land treatment program will achieve this level of protection in about 12 years. One alternative was to establish a 7-year project installation period to install the dams, carry out the wildlife education program, and install the needed conservation land treatment practices. This plan would achieve the 90 percent level of protection by using P.L. 566 funds to accelerate the ongoing land treatment program. Accelerated land treatment was not included as part of the project because of priorities for available Soil Conservation Service personnel. Priorities for land treatment are as high or higher within other parts of these counties. Conservation district boards do not wish to shift priorities within their districts. The sponsor's land treatment goal will be fulfilled through the going land treatment program.

Alternative number 1 consists of continuing the present conservation program without project action. An estimated 1,000 acres would be treated at a total cost of \$20,900. Flood damages would be reduced by 1 percent. Net project benefits of \$12,300 would be foregone annually.

Alternative number 2, the Environmental Quality plan, consists of accelerating the current land treatment program to achieve 90 percent of the needed conservation land treatment in the watershed over the 4-year installation period and conducting a wildlife habitat education program. Flood damages would be reduced by 1 percent more than with the going program. Accelerating the going land treatment program would treat a total of 3,051 acres. Soil loss in the watershed would be reduced by 15,300 tons per year and sediment carried to the Republican River would be reduced by 3,600 tons per year. This level of development would cost \$80,000 more than the going program over the 4-year installation period. Local residents would have a better understanding of the importance of riparian woodland to wildlife, and would better understand proper management techniques. Economic benefits from this plan were not evaluated.

Alternative number 3, the National Economic Development plan, consists of floodwater retarding dams 1 and 2, and an accelerated land treatment program to complete 75 percent of the needed land treatment. Structure Nos. 1 and 2 were selected following an incremental analysis of several possible

FIGURE 1  
LOCATION MAP



dam sites in conjunction with recommended land treatment practices. Soil loss in the watershed would be reduced by 5,400 tons annually. Sediment yield to the Republican River would be reduced by 3,800 tons per year. Terrestrial wildlife habitat totaling 65 acres would be converted to aquatic habitat. Intermittent streams totaling 1.9 miles would be converted to permanent water. Income in the region would increase slightly. Flood protection would reduce damages by 61 percent. Total benefits would average \$44,800 annually. Project installation, operation and maintenance, and project administration costs would average \$25,900 annually. Installation would cost \$357,100.

Alternative number 4 is the selected plan consisting of Structure Nos. 1, 2 and 5; and a wildlife habitat educational program. It would reduce the average annual damages on 1,480 acres within the watershed by 77 percent as follows: crop and pasture - \$17,200; other agricultural facilities - \$4,000; road and bridge - \$2,600; railroad - \$1,500; flood plain scour - \$400; and indirect items - \$2,800. The project would also reduce the average annual damages to 1,280 acres outside the watershed as follows: crop and pasture - \$16,500; other agricultural facilities - \$1,000; and indirect items - \$1,700. Total average annual project benefits are \$52,400. Average annual costs are \$29,300 for project installation, \$1,900 for operation and maintenance, and \$8,900 for project administration. Total average annual project costs are \$40,100. Total installation costs are \$555,600.

Alternative number 5 includes an accelerated land treatment program and floodwater retarding dam Nos. 4 and 5. Sediment yield to the Republican River would be reduced by 6,800 tons per year. Erosion would be reduced by the land treatment program. About 75 acres of terrestrial wildlife habitat would be converted to aquatic habitat. About 0.5 mile of ephemeral stream and 0.6 mile of intermittent stream would be converted to permanent water, and 11.92 square miles of drainage area would be controlled. Installation costs for the two structures would be about \$577,100. Costs exceeded benefits for this alternative. This alternative would not protect upper reaches of the flood plain.

Alternative number 6 is to install an accelerated land treatment program and floodwater retarding dam No. 6. Sediment yield to the Republican River would be reduced by 6,900 tons annually. Erosion would be reduced by the land treatment program. About 86 acres of terrestrial habitat will be converted to aquatic habitat and 2.1 miles of intermittent stream channels would be covered by water. The

structure would control 12.97 square miles of drainage area. Structural installation costs would be about \$516,300. Benefits were not evaluated for this alternative. This alternative would reduce flood damages in the lower portion of the watershed and along the Republican River, but would not protect upper reaches of the flood plain.

Alternative number 7 is nonstructural. Agricultural flood damages would be reduced by converting flood plain cropland to grassland. This alternative would cost about \$680,000 to convert cropland to grassland. Watershed farm income would be reduced by about \$240,000 annually. Conversion of cropland to grassland is not a viable alternative for this watershed.

#### SHORT-TERM USE vs. LONG-TERM PRODUCTIVITY

Land use has varied little within the watershed for the past 15 years. Approximately 97 percent of the watershed is used for continuous agricultural production. This is not likely to change. Project installation is not expected to affect land use except at structure sites.

A long-term commitment of 250 acres of land to dams, spillways, sediment pools, and floodwater retarding pools will be made. Project structural measures are expected to remain in place after the 100-year project life. If maintained, they will continue to provide flood protection and a reduced level of sediment control.

Individual floods are short-term problems, but flooding, as a type of problem, is recurring, persistent, and detrimental to long-term productivity. This project will reduce damage from each flood and increase the long-term productivity potential of the protected land.

Dry Creek Watershed is the only active P.L. 566 watershed project in the Republican River portion of the Kansas River Basin in Kansas. Impacts on man's environment and long-term productivity will be relatively minor outside the watershed.

#### COMMITMENTS OF RESOURCES

Agricultural use and terrestrial wildlife use will be lost on 82 acres inundated by sediment pools. These uses will be interrupted periodically on 155 acres in floodwater retarding areas. The 13 acres to be used for dams and spillways will be lost for agricultural use. Reservoirs will inundate 2.5 miles of intermittent stream.

Construction of the floodwater retarding dams will require 4.9 man years of labor. Operation and maintenance of the structures will require 0.2 man years of labor annually. Construction will require energy equivalent to 3.6 billion Btu's (26,600 gallons of diesel fuel). Total project installation cost will be \$555,600.

#### PROJECT FORMULATION

In 1962-1963 watershed residents organized Dry Creek Watershed Joint District No. 57 according to Kansas law. The watershed district prepared an application for P.L. 566 assistance and submitted it to the Soil Conservation Service on March 5, 1964. The Kansas Watershed Review Committee made a field examination, and approved the application on May 4, 1964.

The Soil Conservation Service conducted a preliminary investigation of problems and potential solutions and made a preliminary report of findings. Based on this preliminary report, planning authorization was requested on June 14, 1971, and was approved on November 1, 1971.

Hydrologic, geologic, engineering, and economic investigations were completed for several watershed alternatives.

As planning proceeded the Water Resources Council, directed by the United States Congress, developed a new set of guidelines for evaluating watershed projects. The new Principles and Standards for Water Resource Planning require identification of a National Economic Development Alternative and an Environmental Quality Alternative. In October 1973 these Principles and Standards became mandatory.

An environmental assessment file has been accumulated for the watershed area.

Public meetings were held on August 15, 1977, and March 13, 1978, to discuss environmental assessment, national economic development and environmental quality plans, to answer questions, and solicit ideas.

Since formal incorporation of Dry Creek Watershed Joint District No. 57, the district board has continued a public information program. Some activities of this program are listed below:

1. Quarterly or on-call meetings open to the public. Specialists have usually been available to discuss specific watershed problems and planning needs.

2. Annual meetings, advertised in advance in the principal county newspapers.
3. Meetings as necessary between watershed board and other sponsors' representatives, and officials of city, township, county, and state governments.
4. Frequent person-to-person contacts between watershed directors and individual farmers to explain the program and encourage application of land treatment measures. Most farmers in the watershed have been contacted.
5. Public informational meetings and a public hearing on the watershed district general plan and method of financing will be held as required by the Kansas Watershed District Act before the federal watershed plan is approved for installation.
6. Tours of operational watersheds.

Sponsoring conservation districts fully support the proposed watershed program. News media, business people, and others are backing the project. There has been substantial opportunity for residents and landowners in the watershed to participate in formulating project objectives and alternative actions.

Investigations of structural locations were made to determine impacts on wildlife habitat. The Soil Conservation Service and sponsors worked together to determine the maximum level of habitat replacement consistent with sponsor capabilities.

Archeological, architectural, and historical resources in the watershed were surveyed to determine the impact of the proposed project.

A public meeting was held September 10, 1979, to discuss the draft plan. Sections reviewed included the planned project, project benefits, environmental setting, water and related land resource problems, environmental impacts, and alternatives. A question and answer session was a part of the meeting. About 34 persons attended this meeting. There were no adverse comments pertaining to implementation of the plan.

The following agencies, conservation groups, and organizations were asked to comment on the draft plan and technical appendix:

\*Department of the Army  
\*Department of the Interior  
Department of Commerce  
Department of Health, Education, and Welfare  
Environmental Protection Agency  
\*Governor of Kansas  
\*Kansas State Water Resources Board, State of Kansas  
(Clearinghouse)  
National Wildlife Federation  
National Audubon Society  
\*\*State Historic Preservation Officer

\*Comments were received from these agencies. See Appendix C for letters of comments received.

\*\*Commented previously. Letter included in Appendix C.

Each comment expressed during interagency review is presented and discussed as follows:

DEPARTMENT OF THE ARMY (letter dated September 14, 1979)

Comment:

The spillway should be sized to pass between 50 percent and 100 percent of the probable maximum flood without overtopping.

Disposition:

We reviewed the hazard classification of these structures and none of them fit the high hazard category. All are classified as low hazard dams of class "a" category. Because of this condition, the requirement for the spillway to pass between 50 percent and 100 percent of the probable maximum flood without overtopping does not apply.

Comment:

It would be helpful if an appendix were attached which generally outlines the wildlife education program.

Disposition:

The proposed wildlife information program is described on pages 9 and 34.

U.S. FISH AND WILDLIFE SERVICE (letter dated August 31, 1979)

Comment:

The loss of wildlife habitat should be recognized as a major problem on page 2.

Disposition:

We have altered the paragraph to read as follows: "About five percent of the Dry Creek Watershed, or 714 acres, is categorized as riparian woodland. Conversion of any of these few acres to cropland or other uses reduces the wildlife population. Loss of wildlife habitat is a major problem within the watershed."

Comment:

Will the relocation of the power line and the telephone line, discussed on page 4, result in the loss of additional wildlife habitat, particularly woodland, beyond that caused by the project?

Disposition:

The utilities relocation will not result in any additional habitat loss.

Comment:

We encourage the planting of native prairie species rather than domestic grasses. We assume native grasses will be planted, but this should be mentioned on pages 4 and 5.

Disposition:

We have added the following sentence: "These plantings will be of native grasses, forbs, and trees."

Comment:

Due to the demise of native prairie and its importance to wildlife, this habitat type should be separated from domestic pasture and cropland if possible on page 34.

Disposition:

We show acres of pasture land, rangeland, and cropland on page 28. Rangeland comprises approximately 20 percent of

the land use in the watershed. Therefore, rangeland is not a critical habitat type in Dry Creek Watershed and need not be separated from the other herbaceous types.

Comment:

The statement "Aquatic and woodland habitat are rare in the watershed due to a lack of water and trees" adds nothing to the fourth paragraph of page 34 and should be omitted.

Disposition:

The sentence has been deleted as suggested.

Comment:

Why not evaluate the economic benefits of land treatment in Appendix C? Land treatment is a major component of the EQ alternative. The economics of the NED plan and the EQ Plan could be compared if an economic analysis of land treatment measures was performed.

Disposition:

It is SCS policy not to evaluate land treatment benefits.

KANSAS FISH AND GAME COMMISSION (letter dated August 28, 1979)

Comment:

We recommend the land use terminology relating to riparian woodland shown on Table A, page 28, and Table C, page 30, be revised to show consistency between the tables and watershed plans of other projects.

Disposition:

We have changed "Woodland" to "Upland Woodland" and "Riparian Habitat" to "Riparian Woodland." In addition, we have added a footnote stating that the 542 acres of riparian woodland are located above the proposed sites and benefited area along small tributaries. We have changed "Woodland" in Tables C and D to "Riparian Woodland" and added a footnote to show that six acres of Upland Woodland are included.

DEPARTMENT OF THE INTERIOR (letter dated August 22, 1979)

Comment:

We find no mention of administration of water rights or an ability to make releases to meet downstream senior requirements.

Disposition:

This information appears on page 6, paragraph 3.

### References

1. All information and data, except as otherwise noted by reference to source, were collected during watershed planning investigations by the Soil Conservation Service, and Forest Service, U.S. Department of Agriculture.
2. U.S. Department of Commerce, Bureau of the Census, U. S. Census of Population: 1970--Number of Inhabitants, Kansas.
3. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Local Climatological Data, 1975.
4. U.S. Department of the Interior, Geological Survey, Water Resources Data for Kansas, Part 1, Surface Water Records, 1961 to 1975.
5. Kansas State Department of Health and Environment, Kansas Surface Water Quality Standards, effective May 1, 1978.
6. U.S. Department of Agriculture, Soil Conservation Service, Chemical Analysis of Pesticide Residues in Fish, October 22, 1976.
7. U.S. Department of Health, Education, and Welfare, Food and Drug Administration, Administrative Guidelines Manual, Chapt. 20, Guideline 7420.09, 1973.
8. List of Endangered and Threatened Wildlife and Plants, Federal Register, Vol. 44, No. 12, Wednesday, January 17, 1979.
9. Kansas Fish and Game Commission, Nongame, Threatened, or Endangered Species, Article XV, General Regulations 23-15-1.
10. U.S. Department of Commerce, Bureau of the Census, Census of Agriculture, 1969, Volume I, Area Reports, Part 21 Kansas, Section 1, Summary Data and Section 2, County Data.
11. U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1970, Detailed Characteristics, U.S. Summary PC(1)-ID and Kansas PC(1)-518.
12. U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population: 1970, General Social and Economic Characteristics, Kansas PC(1)-C18.
13. Kansas State Historical Society, Historic Preservation in Kansas, Vol. 2, 1973 Inventory of Historic Sites, 1973 and Historic Preservation in Kansas Vol. 2, 1974 Supplemental Inventory of Historic Sites, 1974.

14. U. S. Department of the Interior, National Park Service, The National Register of Historic Places, February, 1978.
15. Kansas State Historical Society, "Phase I Archeological Records Review in the Dry Creek Watershed, Clay, Cloud, Republic, and Washington Counties, Kansas," February, 1978.
16. Kansas State Historical Society, personal correspondence with Joseph W. Snell, February 24, 1978.

APPENDIX B

Display Accounts for Selected Alternative

National Economic Development Account

Environmental Quality Account

Regional Development Account

Social Well-Being Account



## SELECTED ALTERNATIVE

## NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

## DRY CREEK WATERSHED, KANSAS

Measures of effects  
(average annual dollars)b/

<u>Components</u>	<u>Components</u>	<u>Components</u>	<u>Components</u>	<u>Components</u>
<b>Beneficial effects</b>				
A. The value to users of increased outputs of goods and services.	A. The value of resources required for a plan	1. Project installation <u>a/</u>	2. Project administration <u>a/</u>	
Flood Prevention <u>c/</u>	52,400	Operation, Maintenance, and Replacement		
Total beneficial effects	52,400	54	1,900	
				40,100
				Net beneficial effects
				12,300

a/ Amortized at 6 7/8 percent interest rate for 100 years.

b/ Price Base: 1978

c/ Price Base: Current normalized for crop and pasture and flood plain scour, WRC October 1978. Other items 1978 prices.

Note: Land treatment beneficial effects were not evaluated.

July 1979

SELECTED ALTERNATIVE  
ENVIRONMENTAL QUALITY ACCOUNT  
DRY CREEK WATERSHED, KANSAS

<u>Components</u>	<u>Measures of effects</u>
Beneficial and adverse effects	
A. Areas of natural beauty	<ol style="list-style-type: none"><li>1. Improve appearance of forest land and rangeland through additional plantings, farm ponds, better management, and fire control.</li><li>2. Increase landscape diversity by creation of 3 lakes average 27 acres each.</li><li>3. Inundate 82 acres of land, 2.46 miles of intermittent stream.</li></ol>
B. Quality considerations of water, land, and air resources	<ol style="list-style-type: none"><li>1. Reduce the total sediment load at the mouth of Dry Creek by 45 percent.</li><li>2. Reduce scour on 32 acres of flood plain.</li><li>3. Control flood runoff from 42 percent of the watershed to reduce flood plain damage 76 percent and decrease average peak flood flow by 63 percent at the watershed outlet.</li><li>4. Temporarily increase erosion and air and water pollution during construction.</li></ol>

SELECTED ALTERNATIVE

ENVIRONMENTAL QUALITY ACCOUNT  
(continued)

DRY CREEK WATERSHED, KANSAS

<u>Components</u>	<u>Measures of effects</u>
C. Biological resources and selected ecosystems	<ol style="list-style-type: none"><li>1. Enhance habitat, food supply, and water source for terrestrial wildlife on 4,848 acres of grassland and forest land through the educational program.</li><li>2. Provide 3 areas on private land for wildlife management.</li><li>3. Inundate 2.5 miles of intermittent stream and 82 acres of terrestrial habitat.</li><li>4. Cause a net loss of 67 habitat units of stream, and 241 habitat units of herbaceous, and a net gain of one habitat unit of woodland.</li></ol>
D. Irreversible or irretrievable commitments	<ol style="list-style-type: none"><li>1. Permanently inundate 82 acres including 2.5 miles of intermittent stream</li><li>2. Occasionally flood 155 acres in floodwater retarding pools.</li><li>3. Construct dams and spillways on 13 acres.</li></ol>

SELECTED ALTERNATIVE

REGIONAL DEVELOPMENT ACCOUNT

DRY CREEK WATERSHED, KANSAS

		Measures of effects (average annual dollars) <sup>a/</sup>			Measures of effects (average annual dollars) <sup>b/</sup>	
		Components		Components		
		State of Kansas	Rest of Nation	State of Kansas	Rest of Nation	
Beneficial effects		Adverse effects			Adverse effects	
A.	The value of increased output of goods and services to users residing in the region	\$52,400 <sup>c/</sup>	0	A.	The value of resources contributed from within the region to achieve the outputs	- 57
1.	Flood prevention			1.	3 Floodwater retarding structures	-
2.	Additional wages and salaries accruing to the region from implementation of the plan and Project Operation, Maintenance, and Replacement	3,700	-3,700	2.	Project installation/ Operation, Maintenance, and Replacement	1,900
B.	The value of output to users residing in the region from external economies associated with increased net returns from agricultural production	3,700	-3,700	3.	Project administration/ Losses of output resulting from external diseconomies to users residing in the region	200
				1.	Indirect activities reservoir take area	4,200
						-4,200
Total	beneficial effects	59,800	-7,400	Total adverse effects	9,700	30,400
				Net beneficial effects	50,100	-37,800

a/

Amortized at 6 7/8 percent interest rate for 100 years.

Price Base: 1978

b/

Current normalized for crop and pasture and flood plain scour, WRC October 1978. Other items 1978

Price Base: 1978

c/

Current normalized for crop and pasture and flood plain scour, WRC October 1978. Other items 1978

July 1979

## SELECTED ALTERNATIVE

REGIONAL DEVELOPMENT ACCOUNT  
(Continued)

## DRY CREEK WATERSHED, KANSAS

Components	Measures of effects			58	- 1			
	State of Kansas	Rest of Nation	Components					
Employment								
<b>Beneficial effects</b>								
A. Increase in the number and types of jobs								
1. Agricultural employment	1.8 man-years annually		1. Lost agricultural employment	0.3 man-year annual employment				
2. Employment for project construction	4.9 years semi-skilled employment during installation		2. Lost in indirect and induced employment associated with project take area	0.2 permanent semi-skilled job				
3. Employment for project Operation Maintenance and Replacement	0.2 permanent semi-skilled job		Total adverse effects	0.5 permanent semi-skilled job				
4. Indirect and induced employment for project installation and output of project's goods and services	0.4 permanent semi-skilled job		Net beneficial effects	1.9 permanent semi-skilled jobs				
<b>Total beneficial effects</b>								
2.4 permanent semi-skilled jobs								
4.9 man-years semi-skilled jobs during installation								

4.9 man-years semi-skilled jobs during installation

July 1979

SELECTED ALTERNATIVE

REGIONAL DEVELOPMENT ACCOUNT  
(continued)  
DRY CREEK WATERSHED

<u>Components</u>	<u>Measures of effects</u>	
	<u>State of Kansas</u>	<u>Rest of Nation</u>
Population distribution		
Beneficial effects	Creates 1.9 permanent semi-skilled jobs and 4.4 semi-skilled jobs during installation	-
Adverse effects	-	-
Regional economic base and stability		
Beneficial effects	Creates 1.9 semi-skilled jobs and 4.4 man years short term semi-skilled jobs in an area where 17.0 percent of the fami- lies have incomes less than the national poverty level	-

SELECTED ALTERNATIVE  
SOCIAL WELL-BEING ACCOUNT  
DRY CREEK WATERSHED

Components

Measures of effects

Beneficial and adverse effects

A. Real income distribution

1. Create 1,9 low to medium income permanent jobs for area residents
2. Create regional income benefits of \$59,800 distributed by income class as follows:

<u>Income Class (dollars)</u>	<u>Percentage of Adjusted Gross Income in Class</u>	<u>Percentage Benefits in Class</u>
Less than 3,000	18	18
3,000-10,000	56	56
More than 10,000	26	26

3. Local costs to be borne by region total \$9,700 with distribution by income class as follows:

<u>Income Class (dollars)</u>	<u>Percentage of Adjusted Gross Income in Class</u>	<u>Percentage Benefits in Class</u>
Less than 3,000	18	18
3,000-10,000	56	56
More than 10,000	26	26

B. Life, Health, & Safety

1. Provide 77 percent floodwater damage reduction.
2. Increase chance of drowning.



APPENDIX C

Summary Comparison of Alternative Plans



SUMMARY COMPARISON OF ALTERNATIVE PLANS

DRY CREEK WATERSHED, KANSAS

<u>ACCOUNT</u>	<u>SELECTED PLAN</u>	<u>NED PLAN</u>	<u>E.Q. PLAN</u>
<u>National Economic Development</u>			
Income (dollars):			
Beneficial effects	\$52,400	\$44,800	<u>a/</u>
Adverse effects	40,100	25,900	<u>a/</u>
Net beneficial effects	12,300	18,900	<u>a/</u>
<u>Environmental Quality</u>			
Beneficial and adverse			
A.	Areas of natural beauty		
	Increase landscape diversity with water in sediment pools - no. of lakes	3	2
B.	Quality considerations of water, land, and air resources		0
	Total sediment yield to Republican River - tons/year	6,400	7,700
			7,900

SUMMARY COMPARISON OF ALTERNATIVE PLANS  
(continued)

<u>ACCOUNT</u>	<u>SELECTED PLAN</u>	<u>NED PLAN</u>	<u>E.Q. PLAN</u>
<u>Environmental Quality</u>			
Reduce erosion from significant sediment source areas (8-15 tons/acre) - acres	83	83	247
Reduce erosion on moderate sediment source areas (4-8 tons/acre) - acres	708	708	2,038
Flood plain scour reduction on 32 acres - percent	56	44	0
C. Biological resources & selected ecosystems			
Designated terrestrial wildlife habitat - acres	22	15	0
Convert terrestrial wildlife habitat to aquatic habitat - acres	82	56	.0
Convert intermittent stream to permanent water - miles	2.5	1.9	0

SUMMARY COMPARISON OF ALTERNATIVE PLANS  
(continued)

ACCOUNT	SELECTED PLAN	NED PLAN	E.Q. PLAN
<u>Regional Development</u>			
State of Kansas			
A. Income (Dollars):			
Beneficial effects	\$59,800	\$54,500	<u>a/</u>
Adverse effects	9,700	6,400	<u>a/</u>
Net beneficial effects	50,100	48,100	<u>a/</u>
B. Employment:			
Project construction (man years)	4.9	3.3	.5
Project operation and maintenance (man years)	.2	.1	0
Agricultural (man years)	1.8	1.4	0
Indirect from project construction (man years)	.4	.3	0
<u>Social Well-Being</u>			
Beneficial and adverse effects			
A. Real income distribution			
1. Create a net increase of low to medium in- come permanent jobs for area residents (man years)	1.9	1.2	0
			July 1979

SUMMARY COMPARISON OF ALTERNATIVE PLANS  
(continued)

<u>ACCOUNT</u>	<u>SELECTED PLAN</u>	<u>NED PLAN</u>	<u>E.Q. PLAN</u>
2. Create regional income benefits - (dollars) (distributed as shown for selected alternative in the Social Well-Being Account)	\$59,800	\$54,500	<u>a/</u>
3. Local costs to be borne by region (dollars) (distributed same as regional income benefits)	9,700	6,400	<u>a/</u>
B. Life, Health, & Safety			
Provide flood protection to flood plain land - percent damage reduction	77	61	1

a/ Economic effects of E.Q. land treatment program were not evaluated.

Note: Land treatment beneficial effects were not evaluated.

July 1979



DEPARTMENT OF THE ARMY  
KANSAS CITY DISTRICT, CORPS OF ENGINEERS  
700 FEDERAL BUILDING  
KANSAS CITY, MISSOURI 64106

REPLY TO  
ATTENTION OF:

MRKED-BP

14 September 1979

Mr. John W. Tippie  
State Conservationist  
Soil Conservation Service  
Box 600  
Salina, Kansas 67401

Dear Mr. Tippie:

This is in response to your letter of 25 July 1979 in which you requested review of your draft Dry Creek Watershed Plan. Members of my staff have reviewed the draft and we offer the following comments.

The information submitted, with respect to Department of the Army permits, reveals that the proposed project will not involve the discharge of dredged or fill material into any stream that has a median flow greater than 5 cubic feet per second (c.f.s.). Under Federal regulation 33 CFR 320-329, published in the 19 July 1977 Federal Register, discharges of dredged or fill material into a stream where the median flow is less than 5 c.f.s. are permitted by nationwide permits.

However, in accordance with the inclosed copy of Excerpts From 33 CFR Part 32, the management practices are to be followed to the maximum extent practicable and the special conditions must be satisfied prior to any discharge of dredged or fill material into any stream at the site of the project.

After construction, the dams may be inspected under the National Dam Inspection Program. For dams of this size, the spillway should be sized to pass between 50 percent and 100 percent of the probable maximum flood without overtopping. The design of these dams should be checked to insure compliance with the guideline criteria. A copy of the guidelines is included with these comments.

MRKED-BP

Mr. John W. Tippie

14 September 1979

It would be helpful if an appendix were attached which generally outlines the wildlife education plan.

We appreciate the opportunity to review this draft watershed plan.

Sincerely,



PAUL D. BARBER

Chief, Engineering Division

2 Incl  
As stated



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

2701 Rockcreek Parkway, Suite 106  
North Kansas City, Missouri 64106

KANSAS CITY AREA OFFICE  
816/374-6166

ECOLOGICAL SERVICES  
816/374-5951

August 31, 1979

Mr. John W. Tippie  
State Conservationist  
Soil Conservation Service  
Box 600  
Salina, KS 67401

Dear Mr. Tippie:

We have reviewed the draft watershed plan, dated July 1979, for the Dry Creek Watershed located in Clay, Cloud, Republic, and Washington Counties, Kansas and offer the following comments:

### Page 2, Paragraph 4, Problems

The loss of wildlife habitat should be recognized as a major problem within the watershed. Although this fact is alluded to, it is not made explicit.

### Page 4, Paragraph 7

Will the relocation of the power line and the telephone line result in the loss of additional wildlife habitat, particularly woodland, beyond that caused by the project?

### Page 4, Last Paragraph and Page 5, Paragraph 1

We encourage the planting of native prairie species rather than domestic grasses. We assume native grasses will be planted, but this should be mentioned in the paragraph.

### Page 34, Paragraph 3

Due to the demise of native prairie and its importance to wildlife, this habitat type should be separated from domestic pasture and cropland if possible.

### Page 34, Paragraph 4

The statement "Aquatic and woodland habitat are rare in the watershed due to a lack of water and trees" adds nothing to the paragraph and should be omitted.



*Save Energy and You Serve America*

Page 35, Table G and Page 39, Unavoidable Adverse Impacts 2

Again habitat units of native prairie should be separated from domestic pasture and cropland.

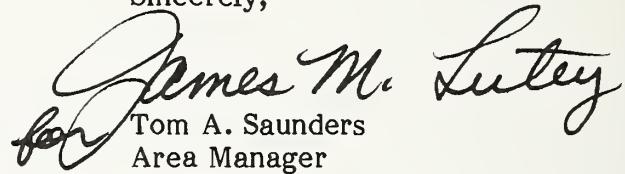
Appendix C

Why not evaluate the economic benefits of land treatment? Land treatment is a major component of the EQ alternative. The economics of the NED Plan and the EQ Plan could be compared if an economic analysis of land treatment measures was performed.

We are encouraged by the wildlife habitat information program involving public presentations, personal contact with each landowner, and field trips. We strongly support this program.

The watershed project should not result in any significant adverse impact on the wildlife resource. Also, limited sport fishing may occur with the project. Therefore, we do not oppose the implementation of the watershed plan as stated.

Sincerely,



for Tom A. Saunders  
Area Manager

cc: RD, Denver, CO (ENV/LWRDP)  
Kansas Fish & Game Commission  
Pratt, KS (Bob Wood)



United States Department of the Interior  
BUREAU OF RECLAMATION

REGIONAL OFFICE, LOWER MISSOURI REGION  
P.O. BOX 25247  
BUILDING 20, DENVER FEDERAL CENTER  
DENVER, COLORADO 80225

IN REPLY  
REFER TO: LM-700

1979

Mr. John W. Tippie  
State Conservationist  
Soil Conservation Service  
P.O. Box 600  
Salina, KS 67401

Dear Mr. Tippie:

Thank you for the opportunity to review the Draft Watershed Plan for Dry Creek Watershed, Clay, Cloud, Republic, and Washington counties, Kansas.

The only comment we have regarding the report is that we find no mention in the text of administration of water rights or an ability to make releases to meet downstream senior requirements. On page 63, the drawing "Typical Earth Dam with Drop Inlet Spillway" indicates a drawdown works which may serve to make such releases, if necessary. If the proposed facilities incorporate this feature, it should be mentioned in the text. Otherwise, provisions should be made in the design of the storage structures to enable releases of this kind should they be required.

Sincerely yours,

Acting for Joe D. Hall  
Regional Director



STATE OF KANSAS



---

OFFICE OF THE GOVERNOR

*State Capitol  
Topeka 66612*

John Carlin *Governor*

September 7, 1979

Mr. John W. Tippie  
State Conservationist  
U.S. Soil Conservation Service  
P. O. Box 600  
Salina, Kansas 67401

Dear Mr. Tippie:

The following comments relative to your transmittal of the draft watershed work plan for the Dry Creek Watershed are submitted for your consideration on behalf of the State of Kansas. They are based on a review by the Kansas Water Resources Board in cooperation with interested state agencies.

The Kansas Water Resources Board advises that the major problems in the watershed are flooding and erosion and that the proposed plan of improvement consisting of three flood retarding dams, constitutes the most desirable of the solutions studied. The Board further advised that the local sponsor, Dry Creek Watershed Joint District No. 57, has expressed a willingness to assume the local responsibilities associated with the project and that the proposed plan, set forth in the draft report, is physically feasible.

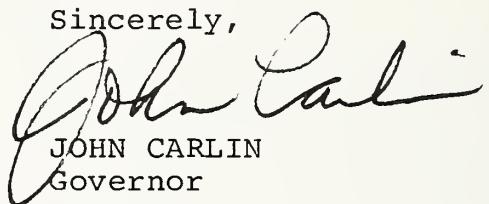
The Kansas Water Resources Board, as part of its coordination efforts, has solicited comments from interested state agencies on the Dry Creek Watershed draft report. Comments received by the Board are supportive of the proposed project. The Kansas Water Resources Board has advised me that the agency comments have been transmitted to your office for your consideration and appropriate action. In view of the above, I believe that the concerns of the State of Kansas have been adequately addressed by your report.

Mr. John W. Tippie  
September 7, 1979  
Page Two

It should be noted that under provisions of Kansas law, approval of plans by the Chief Engineer, Division of Water Resources, Kansas State Board of Agriculture, are required prior to initiation of construction on specific projects. The Kansas Water Resources Board also advises that the proposed developments included in the report are consistent and in accord with the State Water Plan.

In view of the foregoing, I concur in the views expressed by the Kansas Water Resources Board and recommend that the proposed plan be authorized. I urge that this be done at the earliest possible date.

Sincerely,



John Carlin

JOHN CARLIN  
Governor

JC:DCS:ko  
cc: Executive Director  
Kansas Water Resources Board

Mr. Charles Bredahl  
State Soil Conservation Commission  
535 Kansas, 10th Floor  
Topeka, KS 66603

Mr. Guy Gibson, Chief Engineer  
Division of Water Resources  
State Board of Agriculture  
1720 S. Topeka  
Topeka, KS 66612

Mr. Art Ostlund, President  
Dry Creek Watershed Joint  
District No. 57  
Clyde, KS 66938

THE STATE OF KANSAS



WATER RESOURCES BOARD

Suite 303

503 Kansas Avenue

Telephone (913) 296-3185

TOPEKA, KANSAS 66603

September 13, 1979

Mr. John Reh  
Watershed Planning Staff Leader  
U.S. Soil Conservation Service  
P.O. Box 600  
Salina, Kansas 67401

Ref: Dry Creek Watershed

Dear Mr. Reh:

The Board has distributed copies of the Watershed Work Plan for Dry Creek Watershed to interested state agencies for review and comment. Please find enclosed copies of the comments which this office has received. The Kansas Fish and Game Commission, in their comments, expressed some concern on terminology which we feel can be addressed in the final plan.

The Board has recommended approval of the plan to Governor Carlin. Therefore, we would expect the Governor's Office to advise you in the near future of the states' position on this project.

If we can be of any further assistance on this project, please feel free to call on us.

Sincerely,

Larry G. Hess  
Hydrologist III, P.E.

LGH:bb

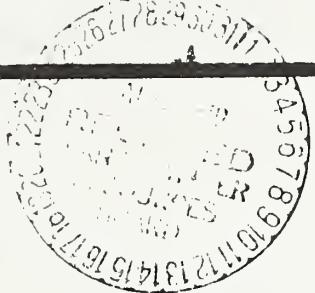
Enclosures



# Kansas Fish & Game

BOX 54A, RURAL ROUTE 2, PRATT, KANSAS 67124

(316) 625-5911



John M. Dewey, Asst. Chief Engineer  
Kansas Water Resources Board  
503 Kansas Ave., Suite 303  
Topeka, KS 66603

Dear Mr. Dewey:

This will respond to your letter of July 31 pertaining to the draft plan Dry Creek Watershed and follow-up on the phone conversation this date between Larry Hess and Bob Wood. We appreciate your office granting our field staff some extra time to review the plan.

It appears the plan adequately addresses the concerns we expressed in our comments of October 26, 1978, to Bob Griffin.

We do have one question concerning terminology. In Table A, page 28, the land uses Woodland and Riparian Habitat are separated when in Table C, page 30, the two have apparently been combined and called Woodland. Also, in Table A, Riparian is subdivided into Flood Plain and Upland. In common usage, there are no riparian upland habitats. We recommend the land use terminology be revised to be consistent with past watershed plans.

If there are any questions about these comments, feel free to contact Bob Wood.

Sincerely,

Jerry M. Conley  
Director, Kansas Fish & Game Comm.

RDW/ddd

cc: Fish Wildlife Service, KS, MO  
NC Regional Headquarters

## REGIONAL OFFICES

Northwest Regional Office  
Box 366, 190 N Franklin  
Colby Kansas 67701

Southwest Regional Office  
808 Highway 56  
Dodge City, Kansas 67801

Northcentral Regional Office  
Box 489, 511 Cedar  
Concordia, Kansas 66901

Southcentral Regional Office  
Box 764, 204 West Sixth  
Neodesha, Kansas 67144

Northeast Regional Office  
Forbes AFB, Box 19086  
Topeka, Kansas 66619

Southeast Regional Office  
222 West Main Building  
Suite C & D  
Chanute, Kansas 66720

Ref: 312.15 Dry Crk

August 28, 1979



# Kansas State Historical Society

120 West Tenth • Topeka, Kansas 66612 • 913/296-3251



August 2, 1979

John M. Dewey  
Water Resources Board  
503 Kansas, Suite 303  
Topeka, Kansas 66603

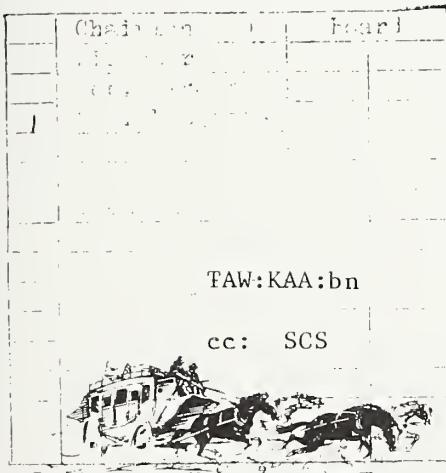
Dear Mr. Dewey:

In regard to the draft copy of the Watershed Work Plan for Dry Creek Watershed District No. 57, we have examined the copy which you provided us and found it to be satisfactory.

The Phase I archeological review conducted by our department in February, 1968, concluded that it was unlikely that significant unrecorded archeological remains would be affected by construction of the four planned reservoirs. Therefore, we recommended that no further archeological investigations be conducted.

The review draft has summarized both our Phase I archeological review, and the Soil Conservation Service obligations to comply with executive orders for the protection of cultural resources in an adequate fashion.

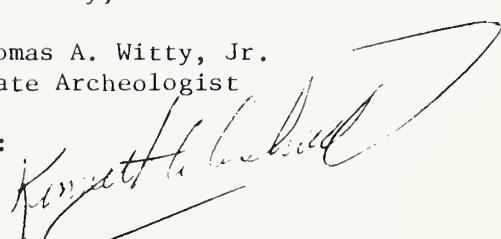
## ROUTING STAMP



Sincerely,

Thomas A. Witty, Jr.  
State Archeologist

By:

  
Kenneth A. Ashworth  
Archeologist

JOSEPH W. SNELL Executive Director  
ROBERT W. RICHMOND Assistant Executive Director  
PORTIA ALLBERT Librarian  
EUGENE D. DECKER State Archivist  
MARK A. HUNT Museum Director  
THOMAS A. WITTY State Archeologist  
JACK W. TRAYLOR Curator of Manuscripts  
FORREST R. BLACKBURN Director of Publications  
RICHARD D. PANKRATZ Director, Historic Preservation Dept.  
LARRY JOCHIMS Research Historian  
M. D. KIDWELL Fiscal Officer  
  
NYLE H. MILLER Executive Director Emeritus  
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# KANSAS STATE BOARD OF AGRICULTURE

## DIVISION OF WATER RESOURCES

GUY E. GIBSON, Chief Engineer  
1720 SOUTH TOPEKA AVENUE  
TOPEKA, KANSAS 66612  
(913) 296-3717

W. W. DUTTSMAN  
Secretary  
503 Kansas Avenue  
TOPEKA, KANSAS 66603

August 22, 1979

Mr. John M. Dewey  
Kansas Water Resources Board  
Suite 303  
503 Kansas Avenue  
Topeka, Kansas 66603

Re: Inter-agency review draft of  
Work Dam of Dry Creek Watershed  
Joint District No. 57

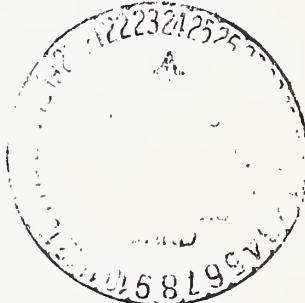
Dear Mr. Dewey:

Pursuant to the provisions of K.S.A. 24-1213 of the Kansas Watershed District Act, the Chief Engineer did act favorably on the General Plan of the above district by approving same on August 6, 1979. We have completed our review of the Work Plan and no further comment or recommendations are forthcoming.

Very truly yours,

Louis C. Jordan  
Engineer

LCJ/acs





# KANSAS DEPARTMENT OF TRANSPORTATION

STATE OFFICE BUILDING TOPEKA, KANSAS 66612



JOHN B. KEMP, Secretary of Transportation

JOHN CARLIN, Governor

ROUTINE

August 20, 1979

Mr. John M. Dewey, Ass't. Chief Engineer  
Kansas Water Resources Board  
Suite 303  
503 Kansas Avenue  
Topeka, Kansas 66603

Dear Mr. Dewey:

Reference is made to the Watershed Work Plan for Dry Creek Watershed Joint District No. 57 and the draft copy which has been sent to the Soil Conservation Service in Salina. This office has reviewed the Watershed Plan and we find that it does not involve any of our prime highways in the area. As a result, we have no specific comments to make at the present time. We wish to thank you for the opportunity of reviewing the Plan and we will keep the copy on file in our offices for future reference.

Very truly yours,

GLENN ANSCHUTZ, P.E.  
ENGINEER OF DESIGN

BY

  
E. WILKINSON, P.E.  
BRIDGE ENGINEER

EW:jkf



# Kansas State Historical Society



ESTABLISHED  
1875

10th AND JACKSON STREETS  
TOPEKA, KANSAS 66612  
PHONE (913) 296-3251

JOSEPH W. SNELL  
ROBERT W. RICHMOND  
PORTIA ALBERT  
EUGENE D. DECKER  
STANLEY D. SOHL  
THOMAS A. WITTY  
JACK W. TRAYLOR  
FORREST R. BLACKBURN  
RICHARD D. PANKRATZ  
M. D. KIDWELL  
NYLE H. MILLER  
EDGAR LANGSDORF

Secretary-Executive  
Assistant Secretary  
Librarian  
State Archivist  
Museum Director  
State Archeologist  
Curator of Manuscripts  
Director of Publications  
Historic Sites Survey Director  
Business Manager

Executive Director Emeritus  
Executive Director Emeritus

February 24, 1978

Mr. Robert K. Griffin  
State Conservationist  
USDA Soil Conservation Service  
P.O. Box 600  
Salina, Kansas 67401

Dear Mr. Griffin:

Our staff has reviewed the environmental assessment of cultural resources in the Dry Creek Watershed supplied to us by your letter of February 17, 1978. This assessment appears to have accurately described the potential impact of this project on cultural resources in the area and it should be considered adequate.

The legal description of both the Thieman and Hanel archeological sites should be deleted from any publication that will be available to the general public. Locations of sites should be provided only to those with a need to know in order to protect the sites from possible vandalism and to protect the landowner from unwanted trespassing.

Very truly yours,

  
Joseph W. Snell, Executive Director and  
State Historic Preservation Officer

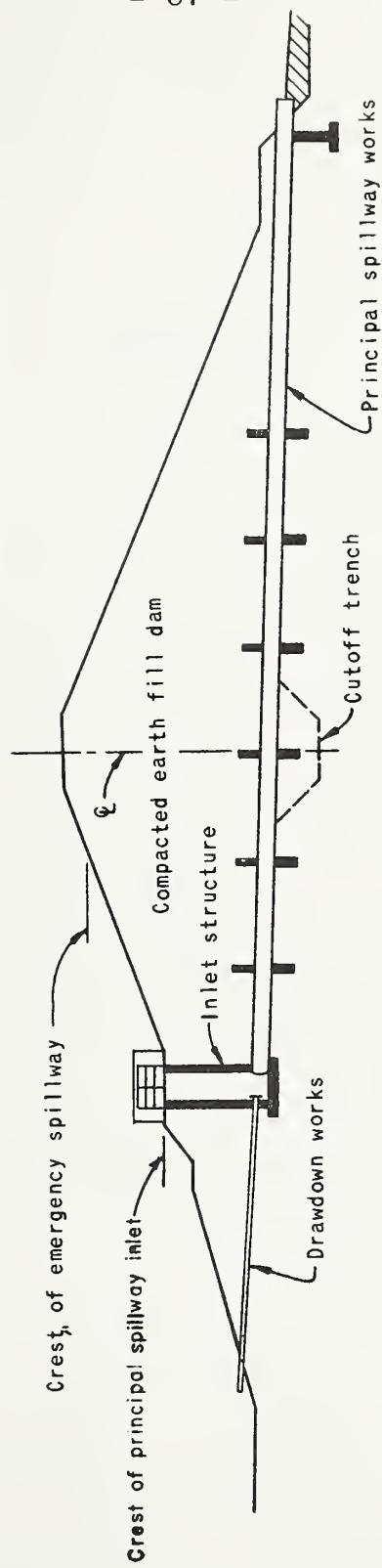


APPENDIX D

Typical Earth Dam with Drop Inlet Spillway



TYPICAL EARTH DAM WITH DROP INLET SPILLWAY



CROSS SECTION OF DAM ON CENTERLINE OF PRINCIPAL SPILLWAY

NOTES:

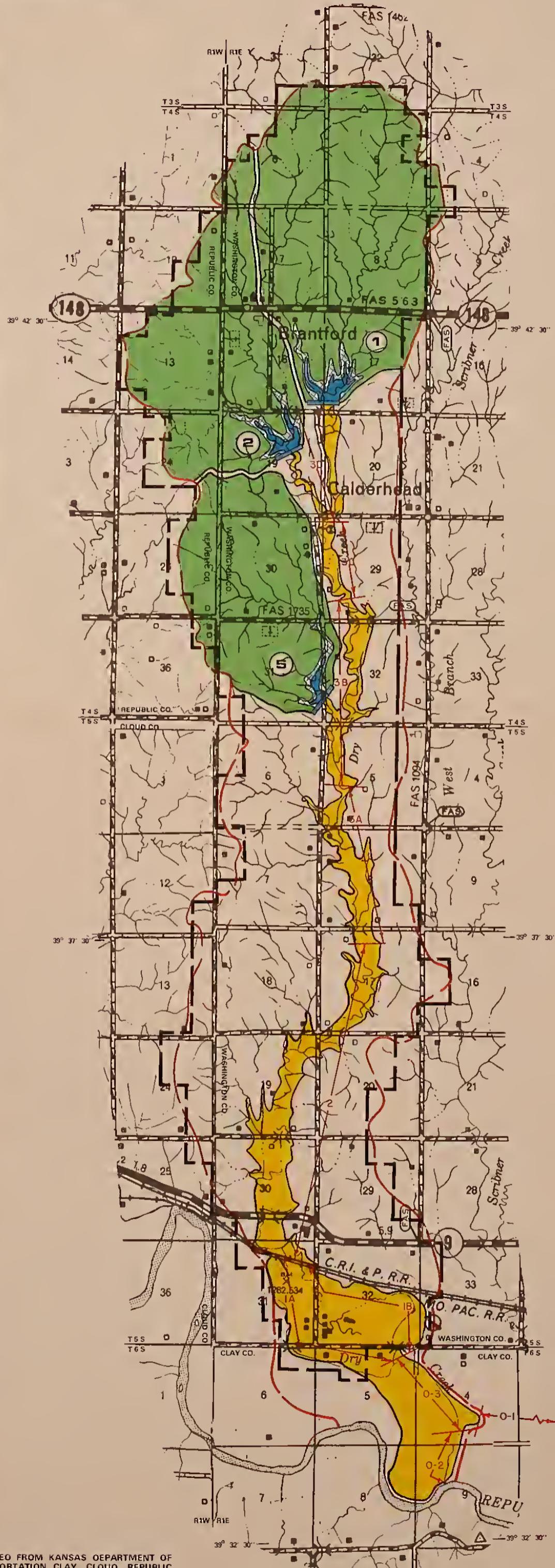
1. FOR INDIVIDUAL STRUCTURE DATA SEE TABLE 3.
2. EMBANKMENT AND FOUNDATION DESIGN FEATURES NOT SHOWN.



APPENDIX F

Project Map



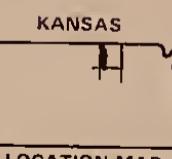


DAM NUMBER AND  
DRAINAGE AREA IN ACRES

①	2822
②	1933
⑤	1666

## LEGEND

- Legal Watershed Boundary
- Natural Watershed Boundary
- Drainage Area Controlled by Floodwater Retarding Dams
- Area Benefited
- 3A → Reaches
- 0-3 → Off Project Reaches
- ⑤ Oam Number
- Floodwater Retarding Storage Pool
- Sediment Storage Pool
- Floodwater Retarding Dam



0 1  
SCALE IN MILES

PROJECT MAP  
DRY CREEK WATERSHED  
CLAY, CLOUD, REPUBLIC AND WASHINGTON COUNTIES  
KANSAS  
FROM INFORMATION FURNISHED  
BY U.S. DEPARTMENT OF AGRICULTURE,  
SOIL CONSERVATION SERVICE  
SEPTEMBER 1978





